Series 1960, No. 31

Issued July 1966

SOIL SURVEY

ELBERT COUNTY, COLORADO EASTERN PART

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
COLORADO AGRICULTURAL EXPERIMENT STATION

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Elbert County, Colo., Eastern Part, contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of the survey area are shown on the detailed map at the back of this report. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the area in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, windbreak group, and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the interpretative groupings.

Ranchers and others interested in range can find, under "Rangeland," groupings of the soils according to their suitability for range, and also descriptions of the vegetation on each range site.

Engineers and builders will find, under "Engineering," tables that give engineering descriptions of the soils in the area and that name soil features that affect engineering practices.

Scientists and others can read about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of the Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text.

Newcomers in the eastern part of Elbert County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area," which gives additional information about the county.

* * * * *

Fieldwork for this survey was completed in 1960. Unless otherwise indicated, all statements in this report refer to conditions in the county at the time the survey was in progress. This survey of Elbert County, Colo., Eastern Part, was made as part of the technical assistance furnished by the Soil Conservation Service to the Agate Soil Conservation District, the Big Sandy Soil Conservation District, and the Horse-Rush Soil Conservation District.

Cover: Typical landscape in the eastern part of Elbert County. This ranch headquarters is near Horse Creek in the Horse-Rush Soil Conservation District. The sloping soils are part of the Yoder-Truckton-Lismas complex. The nearly level soil is Renohill clay loam.

This is the last survey issued in the 1960 series.

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Issued July 1966

SOIL SURVEY OF ELBERT COUNTY, COLORADO EASTERN PART

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

ELBERT COUNTY is near the center of Colorado. Only the eastern part (fig. 1) of the county is included in this survey. The area surveyed is about 553,000 acres in size. It is chiefly a rolling prairie and is now used mainly as range and cropland. Wheat and sorghum are the principal cultivated crops.

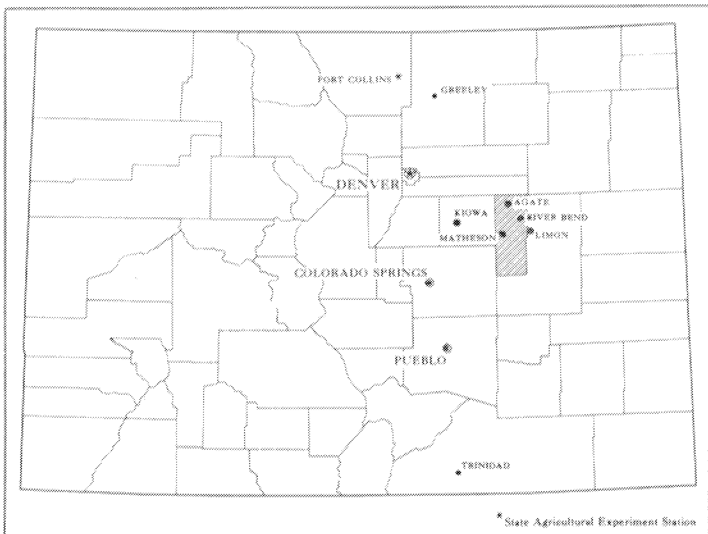

Figure 1.—**Location of Elbert County, Eastern Part, in Colorado.**

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Elbert County, Eastern Part, where they are located, and how they can be used.

They went into the survey area knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the area, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ascalon and Weld, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Christianburg sandy loam and Christianburg clay are two soil types in the Christianburg series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ascalon sandy loam, 3 to 5 percent slopes, is one of several phases of Ascalon sandy loam, a soil type that ranges from gently sloping to moderately steep.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and

[1] Earlier survey work was done by IRVING BROWN, MILO JAMES, and R. G. CASON, of the Soil Conservation Service.

other details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, or occur in individual areas of such small size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Midway-Bainville complex. Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that may occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are so slight that the separation is not important for the objectives of the soil survey. An example is Wiley and Colby soils, 3 to 5 percent slopes. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough gullied land or Riverwash, and are called land types rather than soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil survey reports. On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Elbert County, Colo., Eastern Part. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

In this survey area there are eight soil associations. These are described in the following paragraphs.

1. Weld-Baca-Wiley association

Deep, nearly level to sloping, loamy soils of the uplands

This association occupies benches, ridges, and flats. It is fairly well distributed throughout the western half of the survey area, and one tract is on Cedar Point in the northern part of the survey area. The Weld soils occupy the more nearly level areas, and the Baca and Wiley soils occupy the higher and more sloping areas. The Weld and Baca soils are associated in a fairly uniform pattern; the Wiley soils occur mainly in the area south of Big Sandy Creek. There are a few small, intermittent lakes in the areas of Weld soils.

In the southern part of the survey area, a few small bodies of sloping Platner and Ascalon soils are in this association. In the northern part, small areas of Ascalon, Stoneham, and Renohill soils occur along the edges of the association.

The Weld soils are moderately dark colored. They have a loamy surface layer and a subsoil of blocky silty clay loam or silty clay. The Baca soils are lighter colored and more calcareous than the Weld soils. Their subsoil is blocky silty clay loam, and it is thinner than that of the Weld soils. The Wiley soils are strongly calcareous throughout, and they have a light-colored surface layer and subsoil.

The soils of this association are productive if cultivated. A large part of the association has been broken out of native sod and used for crops, mainly winter wheat, barley, and forage sorghum. Smaller areas are in native range.

2. Bresser-Truckton-Blakeland association

Deep and moderately deep, gently sloping to moderately steep, sandy soils of the uplands

Most of this association is in the western part of the survey area. The Bresser soils are mainly in the more gently sloping areas, the Truckton soils occupy the intermediate slopes, and the Blakeland soils are generally on the rougher slopes and in drainageways where the soil material has been more recently deposited.

The soils in this association are brown, deep and moderately deep, well drained, and moderately sandy to sandy. They developed under a cover of grass in noncalcareous, sandy and gravelly outwash that has been reworked by wind. The Bresser soils are finer textured and have a blockier subsoil than the Truckton soils. The surface layer and the subsoil of the Blakeland soils are loamy sand.

Much of this association, especially the more gently sloping parts, has been broken out of sod and used for crops. The main crops are winter wheat, forage sorghum, and barley. In steep areas and in areas where the Blakeland and Truckton soils are predominant, many fields have been abandoned and reseeded to grass.

3. *Christianburg-Nunn-Arvada association*

Deep and moderately deep, nearly level to gently sloping soils, mainly on stream terraces and alluvial fans

This association occupies medium-sized areas along Big Sandy Creek and other major streams and drainageways. It is mainly in the northern half of the survey area. The Christianburg and Nunn soils normally occupy gently sloping areas on terraces, and the Arvada soils occupy level areas on terraces. All are predominantly clayey, and all are saline and alkali to some degree. Generally, the Arvada soils are the most strongly affected by salts, but in some areas the Christianburg soils also have a high content of salts. The Nunn soils have a slight to moderate content of salts.

The soils of this association are deep and moderately deep, brown to very dark brown, and moderately well drained to very poorly drained. They developed under a cover of grass in alluvium derived mainly from shaly material. The Christianburg soils are dark colored. Their surface layer is silty clay loam, and their subsoil is blocky, very firm clay. The Nunn soils are dark colored. Their surface layer is loam, and their subsoil is blocky clay loam. In many places the Arvada soils have a thin surface layer of light-colored loam or sandy loam. Their subsoil, a dark-colored, blocky very firm clay, has been exposed in some eroded areas.

Most of this association is in native vegetation and is used for grazing. Only about 10 percent of the acreage is cultivated, and most of this acreage consists of Nunn soils. The principal crops are winter wheat, forage sorghum, sweetclover, and barley.

4. *Platner-Ascalon-Stoneham association*

Deep and moderately deep, very gently sloping to moderately steep soils of the uplands

This association occupies extensive tracts in the southeastern and south-central parts of the survey area, south of Big Sandy Creek. The Platner soils generally occupy the more gentle slopes, and the Ascalon and Stoneham soils generally occupy the stronger slopes and the more rolling areas.

The soils of this association are deep and moderately deep, and brown to grayish brown. They developed in calcareous, sandy and gravelly deposits that had been altered by the addition of windblown silty material in many places.

The Platner soils have a loamy surface layer and a subsoil of blocky clay loam. The Ascalon and Stoneham soils have a surface layer of sandy loam. The Ascalon soils have a subsoil of blocky sandy clay loam; the subsoil of the Stoneham soils is blocky loam.

Much of this association is used for crops and is generally productive. A large acreage of Stoneham soils has been reseeded to grass, however, and is used for grazing.

5. *Renohill-Kutch association*

Deep and moderately deep, gently sloping to steep soils of the uplands

This association occupies ridges and sloping areas at the heads of and along tributaries of main streams. It is mostly in the northern half of the survey area, but three small areas occur in the southern half. The Renohill and Kutch soils occupy 70 percent of the association. The rest of the association is occupied mostly by Midway, Bainville, and Lismas soils, which are shallow over shale or fine-grained sandstone. The soils are intricately mingled, and individual soils generally occupy small areas.

The soils of this association are brownish and clayey, and the major soils are deep and moderately deep. All of the soils developed in shaly material weathered from silt and clay or in fine-grained sandy shale and shaly sandstone and siltstone.

The Renohill soils have a surface layer of loam or clay loam and a subsoil of blocky clay loam. The Kutch soils have a surface layer of clay loam and a subsoil of blocky, very firm clay. The Lismas soils are shallow over shale. The Bainville soils are loamy throughout the profile and are shallow over fine-grained sandstone and sandy shale.

Part of this association was formerly cultivated, but most of the acreage is now in grass and is used for range.

6. *Ulm-Midway association*

Deep to shallow, sloping soils of the uplands

This association occupies long, fairly smooth slopes in three widely separated parts of the survey area. One small area is along the northern boundary, another is along the western boundary, and the third is in the northeastern part. The Ulm soils make up the larger part of the association. They have smoother, milder slopes than the Midway soils. Small areas of Renohill soils are in this association, also. Rounded outcrops of argillaceous, fine-grained sandstone are numerous.

The soils of this association are brownish, shallow to deep, and well drained. They developed in material weathered from silty and clayey shale and fine-grained shaly sandstone. The Ulm soils are deep and have a grayish-brown surface layer of very fine sandy loam and loam and a subsoil of blocky clay loam. The Midway soils are shallow over shale and are clay loam throughout the profile.

Most of this association is in native vegetation and is used for range. Only a small part is cultivated; winter wheat and forage sorghum are the main crops.

7. *Vebar-Terry-Tullock association*

Deep to shallow, rolling and sloping to steep, sandy and shaly soils of the uplands

This association is in the northern part of the survey area. It occupies rolling to steep slopes and includes breaks and outcrops of shale and sandstone (fig. 2).

Figure 2.—Outcrops of sandstone are numerous in association 7.

The soils of this association are shallow to deep. They developed in sandy material weathered from fine-grained sandstone and siltstone. The Vebar soils are deep soils that formed in sandy valley fill. The Terry soils are also deep, but they developed partly in eolian material. The Tullock soils are shallow and developed in material weathered from fine-grained sandstone. The Vebar soils have a grayish-brown surface layer. They are loamy fine sand throughout the profile. The surface layer of the Terry soils is sandy loam, and the subsoil is sandy loam or sandy clay loam. The Tullock soils are light colored and are loamy fine sand throughout the profile.

Most of this association is in native range. The Vebar and Terry soils are better suited to range plants than the Tullock soils.

8. Yoder-Blakeland-Lismas association

Shallow to deep, gravelly, sandy, and shaly soils along drainageways in the uplands

This association occupies sloping or steep areas along both sides of main drainageways, mostly in the southern half of the survey area. The Yoder soils are steep, gravelly, and sandy. The Blakeland soils occupy the longer slopes and more rolling areas, mostly in the east-central part of the survey area. The Yoder and Blakeland soils make up the major part of the association. The Lismas soils are intermingled throughout.

The soils of this association are brownish and well drained. The Yoder and Blakeland soils are moderately deep or deep. They developed in gravelly and sandy outwash. The Lismas soils are shallow and occur as shaly outcrops on high points and eroded knobs on the rougher slopes.

Most of this association is in native range. These soils are generally not suitable for cultivation, but a few small areas of Blakeland soils that occur in swales and along the wider drainageways are being used mainly for forage sorghum.

Descriptions of the Soils

This section describes the soil series and mapping units of Elbert County, Eastern Part. The approximate acreage and the proportionate extent of each mapping unit are given in table 1.

A general description of each soil series is given, and it is followed by brief descriptions of the mapping units in that series. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of the description of each mapping unit are the capability unit, the range site, and the windbreak group in which the mapping unit has been placed. The page on which each capability unit, range site, and windbreak group is described can be found readily by referring to the "Guide to Mapping Units," which is at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the section "Genesis, Classification, and Morphology of the Soils." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Arvada Series

In the Arvada series are deep and moderately deep, alkali soils of nearly level and very gently sloping stream terraces and alluvial fans. These soils occur mainly in the area drained by East Bijou Creek. They developed in outwash material derived from dark-gray shale and fine-grained sandstone. The main variations among the Arvada soils are in the content of gypsum and other salts. Slickspots are numerous.

The surface layer is light gray and ranges from 1 to 4 inches in thickness. It erodes easily if not protected, and the subsoil is exposed in places. The subsoil is clayey and has a strong blocky structure. It ranges from 10 to 14 inches in thickness. The color of the subsoil ranges from grayish brown to light yellowish brown. In most places the underlying material is fine textured, but in some areas this material contains fine sand.

The Arvada soils are associated with the Christianburg soils. They have a thinner and grayer surface layer than those soils, and their subsoil has a stronger structure.

Arvada loam, 0 to 3 percent slopes (AaA).—This soil occurs on stream terraces, mainly in the northern half of the survey area. In most places the surface layer is loam, but in some areas it is sandy loam. Generally, it is only 2 or 3 inches thick, and in some spots erosion has removed all of the surface layer and the subsoil is exposed. Grasses and other plants grow in the areas where the surface layer remains, but most of the eroded areas are bare. Small areas of Christianburg clay are included in the areas mapped.

This soil is used mainly for pasture. It is not suited to cultivation. The native vegetation includes western wheatgrass, alkali sacaton, and saltgrass. Some blue grama grows in the more sloping areas. (Capability unit VIs-1, climatic zone C; Salt Flats range site; windbreak group 5)

Arvada complex, 0 to 3 percent slopes, eroded (AcB2).—This complex generally occurs in association with Arvada loam. Erosion has removed the surface layer from large areas and has exposed the subsoil. There are many rills and gullies. Most of the gullies are less than 18 inches in depth, but some are deeper.

These soils are commonly downslope from soils that have excessive runoff. In some places erosion can be controlled by reseeding and constructing diversions to carry runoff, but generally such measures are not feasible.

The native vegetation consists of western wheatgrass, alkali sacaton, and saltgrass. The stands are sparse because the soil is eroded. (Capability unit VIIs-1, climatic zone C; Salt Flats range site; windbreak group 5)

Ascalon Series

In the Ascalon series are deep and moderately deep, sandy soils of the uplands. These soils occur throughout the survey area but are mainly in the southern and eastern parts. They developed in limy, gravelly outwash and in sandy material that had been reworked by wind.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Arvada loam, 0 to 3 percent slopes	1,653	0.3
Arvada complex, 0 to 3 percent slopes, eroded	483	.1
Ascalon sandy loam, 1 to 3 percent slopes	2,335	.4
Ascalon sandy loam, 3 to 5 percent slopes	12,575	2.3
Ascalon sandy loam, 5 to 9 percent slopes	18,638	3.4
Ascalon sandy loam, 9 to 15 percent slopes	739	.1
Ascalon complex, 1 to 3 percent slopes, eroded	80	[1]
Ascalon complex, 3 to 5 percent slopes, eroded	2,776	.5
Baca loam, 3 to 5 percent slopes	7,032	1.3
Baca loam, 5 to 15 percent slopes	18,057	3.3
Baca complex, 5 to 15 percent slopes, eroded	2,643	.5
Badlands	13,414	2.4
Blakeland loamy sand	8,598	1.6
Breaks-Alluvial land complex	1,740	.3
Bresser sandy loam, 1 to 3 percent slopes	7,434	1.3
Bresser sandy loam, 3 to 5 percent slopes	3,134	.6
Bresser sandy loam, 5 to 9 percent slopes	1,656	.3
Bresser sandy loam, 9 to 15 percent slopes	321	[1]
Bresser complex, 3 to 5 percent slopes, eroded	552	.1
Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes	44,847	8.1
Christianburg clay, 0 to 3 percent slopes	18,646	3.4
Christianburg clay, 0 to 3 percent slopes, severely eroded	1,879	.3
Christianburg clay, 3 to 5 percent slopes	798	.1
Christianburg sandy loam, 0 to 3 percent slopes	962	.2
Eastonville loamy sand, 0 to 3 percent slopes	1,589	.3
Eastonville loamy sand, 3 to 5 percent slopes	257	[1]
Fort Collins loam, 0 to 3 percent slopes	2,985	.5
Gravelly land	475	.1
Kutch clay, 1 to 5 percent slopes	1,386	.2
Kutch clay, 5 to 15 percent slopes	1,135	.2
Kutch clay, 5 to 15 percent slopes, severely eroded	538	.1
Lismas clay	2,658	.5
Lismas clay, eroded	1,404	.3
Loamy alluvial land	4,971	.9
Midway-Bainville complex	4,055	.7
Midway-Bainville complex, eroded	917	.2
Midway-Ulm complex	7,686	1.4
Midway-Ulm complex, severely eroded	151	[1]
Nunn loam, 0 to 3 percent slopes	8,416	1.5
Nunn loam, 3 to 5 percent slopes, severely eroded	478	.1
Nunn sandy loam, 0 to 3 percent slopes	1,396	.3
Platner loam, 0 to 1 percent slopes	3,190	.6
Platner loam, 1 to 3 percent slopes	18,091	3.3
Platner loam, 3 to 5 percent slopes	1,392	.2
Platner loam, 5 to 9 percent slopes	768	.1
Platner-Ascalon sandy loams, 0 to 3 percent slopes	40,857	7.4
Platner-Ascalon sandy loams, 3 to 5 percent slopes	10,479	1.9
Renohill clay loam	21,230	3.8
Renohill complex, 3 to 15 percent slopes, eroded	22,037	4.0
Riverwash	543	.1
Rough broken land	1,590	.3
Rough gullied land	192	[1]
Sandy alluvial land	14,902	2.7
Slickspot-Kutch complex, 3 to 9 percent slopes	9,891	1.8
Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded	24	[1]
Stoneham loam, 1 to 3 percent slopes	541	.1
Stoneham loam, 3 to 5 percent slopes	1,026	.2
Stoneham sandy loam, 1 to 5 percent slopes	4,038	.7
Stoneham sandy loam, 5 to 18 percent slopes	8,740	1.6
Stoneham complex, 1 to 5 percent slopes, eroded	1,849	.3
Terry fine sandy loam, 5 to 20 percent slopes	869	.2
Terry-Lismas complex	14,884	2.7
Terry-Lismas complex, severely eroded	833	.2
Terry-Vebar-Tullock complex, 5 to 25 percent slopes	24,181	4.4
Truckton sandy loam, 1 to 3 percent slopes	748	.1
Truckton sandy loam, 3 to 5 percent slopes	4,823	.9
Truckton sandy loam, 5 to 20 percent slopes	6,023	1.1
Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded	4,277	.8
Ulm loam, 1 to 5 percent slopes	1,887	.3
Ulm loam, 5 to 12 percent slopes	6,601	1.2
Ulm loam, 5 to 12 percent slopes, severely eroded	552	.1
Ulm-Beckton complex, 3 to 9 percent slopes	11,391	2.1
Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded	420	.1
Vebar loamy fine sand, 3 to 5 percent slopes	332	.1
Vebar loamy fine sand, 5 to 20 percent slopes	1,146	.2
Weld loam, 0 to 1 percent slopes	4,911	.9
Weld loam, 1 to 3 percent slopes	45,298	8.2
Weld loam, 3 to 5 percent slopes	12,762	2.3
Wet alluvial land	3,367	.6
Wiley and Colby soils, 3 to 5 percent slopes	1,922	.3
Wiley and Colby soils, 5 to 18 percent slopes	3,675	.7
Yoder gravelly sandy loam	268	[1]
Yoder-Truckton-Lismas complex	20,451	3.7
Water	8,510	1.5
Total	553,000	100.0

[1] Less than 0.05 percent.

The surface layer is grayish-brown or brown, granular sandy loam. It ranges from 2 to 8 inches in thickness but most commonly is about 6 inches thick. The subsoil is brown or grayish-brown, blocky sandy clay loam. It ranges from 6 to 18 inches in thickness, but generally is about 12 inches thick. This layer takes water readily and holds it. When dry, it is very hard. The underlying material is pale-brown sandy and gravelly outwash that does not hold much water. In places silty material is mixed with the gravelly outwash.

These soils are easy to work, but they blow easily if cultivated and not protected. On the lesser slopes the most serious erosion hazard is by wind. On the steeper slopes both wind erosion and water erosion are problems. The climate of the survey area becomes progressively drier toward the southern boundary. The effects of wind erosion and winnowing are more serious in the southern part of the area because of the shortage of moisture.

The Ascalon soils are associated with the Platner and Stoneham soils. They are more sandy than the Platner soils. Their subsoil contains less gravel than that of the Stoneham soils and has a stronger structure.

Ascalon sandy loam, 1 to 3 percent slopes (AnB).—This soil is mainly in the central and southeastern parts of the survey area. The surface layer is about 6 inches thick. The subsoil is sandy clay loam and is about 18 inches thick. Small areas of Platner and Stoneham soils are included in the areas mapped.

This soil is easy to work. It takes water readily, and its water-holding capacity is good. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

Nearly all of the acreage is cultivated. Wheat is the principal crop, but barley and sorghum are also grown.

Crops respond to good management. (Capability unit IIIe–2 if in climatic zone B, and IVe–5 if in climatic zone C; Sandy Plains range site; windbreak group 3)

Ascalon sandy loam, 3 to 5 percent slopes (AnC).—This soil is mainly in the southern part of the survey area. Both the surface layer and the subsoil are slightly thinner than those of Ascalon sandy loam, 1 to 3 percent slopes. Some areas of Stoneham and Platner soils are included in the areas mapped. The Stoneham soils are on the steeper slopes.

Surface runoff is medium. The hazard of erosion by either wind or water is moderate. Terracing, stripcropping, stubble mulching, and the use of close-growing crops help to control erosion.

Most of this soil is cultivated. Wheat is the principal crop, but sorghum, millet, and barley are also grown. (Capability unit IIIe–3 if in climatic zone B, and IVe–6 if in climatic zone C; Sandy Plains range site; windbreak group 3)

Ascalon sandy loam, 5 to 9 percent slopes (AnD).—This soil is mainly in the central and southern parts of the survey area. It also occurs in sloping areas along the major drainageways. The surface layer is 2 to 5 inches thick. The subsoil is sandy clay loam and is 8 to 10 inches thick.

The hazard of erosion is severe because of the slope. Terracing, stubble mulching, and the use of close-growing crops help to control erosion.

Most of the acreage is in native range, but cultivated crops are grown in the more gently sloping areas. Wheat is the main crop. (Capability unit IVe–1 if in climatic zone B, and VIe–1 if in climatic zone C; Sandy Plains range site; windbreak group 3)

Ascalon sandy loam, 9 to 15 percent slopes (AnE).—This soil occurs along drainageways. The subsoil is sandy clay loam and is 6 to 8 inches thick. Small areas of Stoneham sandy loam, of Yoder gravelly sandy loam, and of Bresser sandy loam are included in the areas mapped.

This soil is not suitable for cultivation, because of the slope and the erosion hazard. Nearly all of the acreage is in native range. (Capability unit VIe–1, climatic zone C; Sandy Plains range site; windbreak group 3)

Ascalon complex, 1 to 3 percent slopes, eroded (ApB2).—This complex generally occurs within larger areas of Ascalon sandy loam, 1 to 3 percent slopes. In most places erosion has removed the surface layer, and soil material has accumulated along old fence rows in hummocks or small dunes that are more than 20 inches thick. In many areas the removal of the finer material has exposed an accumulation of gravel. Some of the subsoil of sandy clay loam has been removed by erosion. In most places the subsoil is now less than 7 inches thick, and in some areas none of the subsoil remains.

These soils were formerly cultivated, but most areas are now abandoned. Erosion is still active in some areas, but in other places a sparse cover of grass and weeds is stabilizing the soil. A few areas have been reseeded to grass and sweetclover and are well stabilized. (Capability unit VIe–2, climatic zone C; Sandy Plains range site; windbreak group 3)

Ascalon complex, 3 to 5 percent slopes, eroded (ApC2).—This complex generally occurs within larger areas of Ascalon sandy loam, 3 to 5 percent slopes. All, or nearly all, of the surface layer has been removed by wind and water erosion. In many places the substratum is exposed in blowouts.

Surface runoff is rapid. Water erosion is a threat, but wind erosion is a more severe hazard. A combination of plant cover and mechanical control is needed to check erosion.

Most of the acreage has been used for wheat, but the areas formerly cultivated have been seeded to grass and sweetclover or have been allowed to revert to native vegetation. (Capability unit VIe–2, climatic zone C; Sandy Plains range site; windbreak group 3)

Baca Series

In the Baca series are deep, moderately fine textured soils of the uplands. These soils occur mainly in the northern part of the survey area, but there are some small, isolated areas in the central and southern parts. They developed in calcareous, medium-textured material.

In most places the surface layer is light brownish-gray, granular loam that ranges from 2 to 5 inches in thickness. The subsoil is light yellowish-brown, clayey material that has a blocky structure. It ranges from 10 to 20 inches in thickness. The subsoil absorbs water readily and holds it.

These soils are easy to work, but they are subject to severe wind and water erosion unless they are protected by a cover of plants or plant residue.

The Baca soils are associated with the Weld, Wiley, and Colby soils. They are lighter colored than the Weld soils, and their subsoil is less clayey. They are more strongly developed than the Wiley soils and have a finer textured subsoil.

Baca loam, 3 to 5 percent slopes (BaC).—This soil is mainly in the area of Cedar Point and in the northwestern part of the survey area. The surface layer is weakly calcareous. The subsoil is silty clay loam and is about 16 inches thick. Small areas of Weld, Wiley, and Colby soils are included in the areas mapped.

This soil is easy to work. It has a good water-holding capacity. Surface runoff is medium, and the hazard of erosion is slight to moderate. Stripcropping, stubble mulching, contour farming, and terracing help to control both wind and water erosion.

Wheat is the main crop. (Capability unit IIIe–1 if in climatic zone B, and IVe–3 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Baca loam, 5 to 15 percent slopes (BaE).—This soil is mainly in the northwestern and south-central parts of the survey area. The surface layer is thin. The subsoil is silty clay loam and is about 12 inches thick. Small areas of Weld and Wiley soils are included in the areas mapped.

Surface runoff is medium to rapid. The hazard of erosion is slight to moderate.

This soil is not suited to cultivation, because tillage causes erosion and loss of moisture. Most of the acreage is in native range. The vegetation consists mainly of sideoats grama, blue grama, little bluestem, and western wheatgrass. (Capability unit VIe–4 in climatic zone C; Loamy Slopes range site; windbreak group 1)

Baca complex, 5 to 15 percent slopes, eroded (BcE2).—This complex is mainly in the northwestern part of the survey area. Most areas are between 20 and 30 acres in

size, but a few are larger. Some areas of Weld and Wiley soils are included in the areas mapped.

Both sheet and gully erosion are active. In places the surface layer has been removed, and the subsoil is exposed.

These soils are not suitable for cultivation. Building diversions to carry runoff, contour furrowing, and pitting, in conjunction with controlled grazing, will accelerate recovery of the plant cover and help to control erosion.

Formerly, most of this complex was cultivated or intensively grazed, but most of the acreage has been abandoned or reseeded to grass. (Capability unit VIe-5, climatic zone C; Loamy Slopes range site; windbreak group 1)

Badlands

Badlands (Bd) is a land type that occupies extremely rough areas in the north-central and northeastern parts of the survey area. It was formed from interbedded, soft, fine-grained sandstone, siltstone, and shale by the action of water and wind. The slope range is 0 to 40 percent. The material that weathers from these rocks is the kind in which such soils as Terry, Renohill, Bainville, Midway, Ulm, and Lismas develop.

Runoff is very rapid, and erosion is active. Consequently, there has been little or no soil development. Recent deposits occur along the drainageways, which are gullied to varying degree.

Vegetation grows only in small patches of soil material in the drainageways, on the higher lying benches, and in some of the less eroded steep areas. Small isolated areas support a cover of blue grama, sideoats grama, indian ricegrass, western wheatgrass, and a few shrubs. In several places springs and seep areas provide a fair to good supply of water for livestock. It is impractical to use such areas for grazing, however, because they are steep and almost inaccessible.

Wildlife habitats and watersheds are the best uses for Badlands. The hazard of erosion is more severe than on Rough broken land, and there is less soil material to support vegetation. (Capability unit VIIIe-1, climatic zone C; windbreak group 5)

Bainville Series

In the Bainville series are shallow, light-colored soils overlying interbedded shale or fine-grained sandstone. The thickness of these soils ranges from 6 to 18 inches.

The surface layer is light brownish gray; it is medium textured and in most places is less than 3 inches thick. The subsoil is lighter colored than the surface layer. In places it contains fragments of shale and sandstone. The underlying material contains pockets or seams of gypsum.

These soils are not suitable for cultivation. The native vegetation consists of blue grama, western wheatgrass, sideoats grama, and little bluestem.

In this survey area the Bainville soils are mapped only with the Midway soils. The Bainville soils are less deep than the Midway soils, and they are coarser textured. They are much coarser textured than the Lismas soils.

Beckton Series

In the Beckton series are deep, fine-textured, saline soils. They developed in local alluvium and valley fill derived from sedimentary rocks.

The surface layer is gray, thin, and medium textured or moderately coarse textured. The subsoil is grayish brown and fine textured. It has a well-defined, blocky structure. In places the subsoil is exposed. The underlying material is whitish because it contains a large amount of lime.

These soils are suitable only for range. The native grasses include alkali sacaton, western wheatgrass, and blue grama.

In this survey area the Beckton soils are mapped only with the Ulm soils. The uppermost part of the Beckton soils is less alkaline than that of the Arvada soils. The Beckton soils are more alkaline throughout, however, than the Kutch soils.

Blakeland Series

In the Blakeland series are noncalcareous, sandy, gently sloping to rolling soils of the uplands. These soils occur in the northern part of the survey area. They developed in sandy, windblown material.

The surface layer is dark-colored loamy sand or sand. It ranges from 8 to 14 inches in thickness. It grades to lighter colored loamy sand or sand that extends to a depth of more than 5 feet. Even though these soils are very sandy, they are hard enough when dry to be difficult to dig.

These soils are not suitable for cultivation, because their moisture-holding capacity is low and the hazard of erosion is severe if the native vegetation is removed.

The Blakeland soils are associated with the Bresser, Truckton, and Yoder soils. They are more sandy than the Bresser and Truckton soils and contain less gravel than the Yoder soils.

Blakeland loamy sand (Be).—This soil is mainly in the northern and east-central parts of the survey area. The slope range is 3 to 15 percent. The surface layer of loamy sand grades into sand in the lower part of the profile. Small areas of Bresser sandy loam, Truckton sandy loam, and Yoder gravelly sandy loam are included in some of the areas mapped. These included soils make up less than 10 percent of the acreage.

This soil is used principally for native range. Under good management it produces an excellent stand of forage plants, mainly mid and tall grasses. It is not suitable for cultivation, because it is droughty and is highly susceptible to wind erosion if the vegetative cover is removed by cultivation or overgrazing. A few small areas in the swales and within the wider drainageways, mostly in the east-central part of the survey area, are being used for forage sorghum. (Capability unit VIe-8, climatic zone C; Deep Sand range site; windbreak group 2)

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Bk) occurs in the northeastern part of the survey area along Badger and Beaver Creeks. It consists of gullied areas along streams, on the bottoms of narrow, intermittent drainageways where overflow material collects, and on low escarpments at the edges of terraces and channels. The soils are not uniform over any significant area, because of the slope and the erosion pattern. Deep gullies that radiate back from the deepening channels of the streams are

common. As the main streams deepen and widen, streambank cutting adds to the problems caused by erosion. In most places there is no vegetative cover. (Capability unit VIIIe–2, climatic zone C; windbreak group 5)

Bresser Series

In the Bresser series are deep and moderately deep, moderately sandy soils of the uplands. Normally, these soils are noncalcareous throughout, but in a few small areas they are slightly calcareous in the lower part of the subsoil. The soils occur mostly on the higher lying benches and ridges in the western part of the survey area. They developed in sandy material.

The surface layer is grayish-brown sandy loam that ranges from 3 to 8 inches in thickness. It has granular structure and is easy to work, but a protective cover of plants is needed to control blowing. The subsoil is brown and contains more clay than the surface layer. It ranges from 18 to 26 inches in thickness and has a blocky structure. The subsoil absorbs water readily and holds it, but it is very hard when dry. The underlying material is normally sandy; in some places, however, it consists of shale, silt, or old deposits of calcareous gravel.

In this survey area the Bresser soils are mapped in both climatic zone B and climatic zone C. These soils are associated with the Blakeland, Truckton, and Yoder soils. They are finer textured than the Truckton soils, and their subsoil is blockier.

Bresser sandy loam, 1 to 3 percent slopes (BmB).—This soil occurs mostly in the western part of the survey area. Its subsoil is sandy clay loam. Small areas of Truckton soils are included in the areas mapped.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. Terracing, stripcropping, and stubble mulching help to conserve moisture and control erosion. If plant cover is not adequate, emergency tillage to prevent blowing is often necessary. This soil is suited to cultivation. Wheat and sorghum are the main crops. (Capability unit IIIe–2 if in climatic zone B, and IVe–5 if in climatic zone C; Sandy Grassland range site; windbreak group 3)

Bresser sandy loam, 3 to 5 percent slopes (BmC).—This soil occurs mainly in the southwestern part of the survey area. Both the surface layer and the subsoil are somewhat thinner than those of Bresser sandy loam, 1 to 3 percent slopes. Small areas of Blakeland and Truckton soils are included in the areas mapped.

Surface runoff is medium to rapid. The hazard of erosion is slight to moderate. Terracing, stubble mulching, contour farming, and stripcropping help to control erosion and conserve moisture. A large part of the acreage is cultivated. Wheat and sorghum are the main crops. Some areas, however, remain in native grass. (Capability unit IIIe–3 if in climatic zone B, and IVe–6 if in climatic zone C; Sandy Grassland range site; windbreak group 3)

Bresser sandy loam, 5 to 9 percent slopes (BmD).—This soil is in the uplands in the western part of the survey area. The surface layer is about 3 inches thick, and the sandy clay loam subsoil is about 20 inches thick. In a few places material from the subsoil has been mixed with material from the surface layer, and these spots are lighter colored. Some small areas of Blakeland and Truckton soils are included in the areas mapped.

Surface runoff is medium to rapid. The hazard of erosion is moderate. Terracing, stubble mulching, stripcropping, and the use of close-growing crops help to control wind and water erosion.

Most of the acreage is in native range. Wheat and sorghum are the main cultivated crops. (Capability unit IVe–1 if in climatic zone B, and VIe–9 if in climatic zone C; Sandy Grassland range site; windbreak group 3)

Bresser sandy loam, 9 to 15 percent slopes (BmE).—This soil occurs in the uplands. The surface layer is thin, and in places it contains small pebbles. The sandy clay loam subsoil is about 18 inches thick, and its structure is not as strong as that of the more gently sloping Bresser soils. Small areas of Blakeland and Yoder soils are included in the areas mapped.

This soil is not suited to cultivation, and nearly all of it is in native range. If the grass cover is depleted, this soil is highly susceptible to wind and water erosion. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 3)

Bresser complex, 3 to 5 percent slopes, eroded (BrC2).—This complex is in the uplands and adjoins areas of Bresser sandy loam, 3 to 5 percent slopes. Most areas are between 20 and 30 acres in size, but some are larger.

Wind erosion has removed all or nearly all of the surface layer and part of the subsoil. In some old fields the original subsoil has been completely removed. The remnants of the surface layer are coarser textured than is typical of the soils in this complex, because most of the fine particles have been removed by wind.

Most of the acreage was formerly cultivated but has now been abandoned or reseeded to grass and sweetclover. Intensive management is needed to stabilize these soils. (Capability unit VIe–2, climatic zone C; Sandy Grassland range site; windbreak group 3)

Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes (BtD).—This complex occurs on uplands in the southwestern, central, and northwestern parts of the survey area. The soils in this complex are so intricately mixed that they cannot be mapped separately. Bresser sandy loam makes up a major part of the acreage and occupies the smoother part of the landscape. Truckton loamy sand and Blakeland loamy sand occupy the steeper slopes and ridges. A few small tracts of soils similar to the Stoneham soils are included in the areas mapped. These inclusions are mainly in steep areas.

Most of the acreage is in native grass. It is not suited to cultivation, because the slopes are steep and the moisture supply is insufficient. These soils are highly susceptible to wind erosion and will blow easily unless the vegetative cover is adequate. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 3)

Christianburg Series

The Christianburg series consists of fine-textured soils of nearly level and very gently sloping alluvial terraces and fans. These soils developed in stratified clayey alluvium. In most places they are calcareous below a depth of 10 inches, and in a few places they are cal-

careous throughout the profile. These soils are most common along the larger drainageways, mainly Big Sandy Creek and East Bijou Creek.

The surface layer is grayish brown. It ranges from 2 to 7 inches in thickness. It has a granular structure. In some places sandy material from adjacent slopes has been deposited on these soils, and the surface layer in those areas has a moderately coarse texture. The subsoil is very dark grayish brown and contains little more clay than the surface layer. It ranges from 6 to 15 inches in thickness. This layer absorbs water very slowly and holds it very well. When dry, it is very hard. In most places the underlying material is uniformly clayey, but in some areas the clayey material is stratified with coarser textured material. Sand and gravel underlie the stratified material in most places.

The Christianburg soils are associated with the Arvada, Kutch, and Lismas soils. They are not so alkaline as the Arvada soils, and they do not have such well-developed horizons.

Christianburg clay, 0 to 3 percent slopes (CbA).—This soil occurs on alluvial terraces and fans, mainly in the central and northern parts of the survey area. Both the surface layer and the subsoil are clay, and they overlie intermixed coarse-textured and medium-textured alluvium at a depth of 24 inches or more. Small tracts of Arvada soils are included in the areas mapped.

This soil takes water slowly, and surface runoff is slow. The hazard of erosion is slight to moderate.

This soil is difficult to work. It is not suited to cultivation. (Capability unit VIs–1, climatic zone C; Salt Flats range site; windbreak group 5)

Christianburg clay, 0 to 3 percent slopes, severely eroded (CbB3).—This soil adjoins uneroded areas of Christianburg clay, 0 to 3 percent slopes. Its grass cover has been wholly or partly removed; consequently, water erosion has formed many rills and deep gullies. Most of the gullies are not crossable with machinery. In many places the surface layer is thin, and the subsoil is exposed. The hazard of further erosion by water is severe. (Capability unit VIIs–1, climatic zone C; Salt Flats range site; windbreak group 5)

Christianburg clay, 3 to 5 percent slopes (CbC).—This soil occupies alluvial terraces along the major drainageways in the central and northern parts of the survey area. The surface layer is about 2 inches thick. Some tracts of Arvada and Kutch soils are included in the areas mapped.

Surface runoff is medium. The hazard of erosion is slight to moderate.

This soil is not suited to cultivation, because it is difficult to work and receives insufficient moisture. (Capability unit VIe–6, climatic zone C; Clayey Plains range site; windbreak group 5)

Christianburg sandy loam, 0 to 3 percent slopes (ChA).—This soil is on alluvial terraces. The surface layer consists of deposits of sandy material washed from the adjacent slopes. It is 4 to 10 inches thick. The clay subsoil is similar to that of the Christianburg clay soils.

This soil can be used for crops with limited success. The hazard of erosion is slight to moderate. (Capability unit IVe–4, climatic zone C; Loamy Plains range site; windbreak group 3)

Colby Series

The Colby series consists of shallow, well-drained soils of the uplands. These soils developed in calcareous, loamy, and silty material. They occur mainly on Cedar Point and the south-central and northwestern parts of the survey area.

The surface layer is silt loam and is grayish brown when dry and dark grayish brown when moist. It ranges from 2 to 6 inches in thickness. The subsoil is silt loam also and ranges from 4 to 8 inches in thickness. The color of the subsoil is the same as that of the surface layer or is slightly lighter. The subsoil grades into very pale brown silt loam that normally extends to a depth of more than 5 feet.

The native vegetation consists of short grasses, mainly blue grama and buffalograss.

In this survey area the Colby soils are mapped only with the Wiley soils. They are similar to the Wiley soils, but they have a weaker structure and less clay in their subsoil. They have a less fine textured and less well developed subsoil than the Baca soils.

Eastonville Series

The Eastonville series consists of moderately deep, moderately dark colored, noncalcareous, sandy soils on stream terraces. They developed in sandy and gravelly material.

The surface layer is grayish brown and ranges from 7 to 17 inches in thickness. It has a fine crumb structure and is easy to work. Moisture is absorbed rapidly by this layer. The subsoil absorbs water well but, because of the sandy texture, does not hold it. When dry, the subsoil is very hard. The underlying material is sandy and gravelly. In most places it is noncalcareous, but in a few places it is calcareous.

The Eastonville soils are associated with Loamy alluvial land and with Sandy alluvial land. The surface layer of the Eastonville soils is much thicker than that of the higher lying Blakeland soils. Their subsoil is slightly less sandy than that of the Blakeland soils and overlies sediments that are more strongly stratified.

Eastonville loamy sand, 0 to 3 percent slopes (EaA).—This soil occurs on stream terraces, mainly in the southern part of the survey area. The surface layer is about 17 inches thick. The subsoil is sandy loam and ranges from 17 to 20 inches in thickness. Small tracts of Sandy alluvial land are included in the areas mapped.

This soil is flooded occasionally. It is not suitable for cultivated crops, because of the hazard of erosion by both wind and water when it is bare. Some areas are used for alfalfa, sorghum, and small grain, but most of the acreage is in native range. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 2)

Eastonville loamy sand, 3 to 5 percent slopes (EaC).—This soil occurs on stream terraces in the southern part of the survey area. It is more shallow than Eastonville loamy sand, 0 to 3 percent slopes, and has both a thinner surface layer and a thinner subsoil. Small areas of Blakeland and Truckton soils are included in the areas mapped.

This soil is not suited to cultivation, because it is droughty and is susceptible to wind erosion. Nearly all of it is in native range. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 2)

Fort Collins Series

The Fort Collins series consists of moderately deep, light brownish-gray, medium-textured and moderately fine textured soils. These soils occupy nearly level and very gently sloping stream terraces. Their subsoil is loamy. These soils developed in silty and sandy alluvium. They are commonly calcareous in the subsoil and below.

The surface layer is light brownish gray and ranges from 2 to 5 inches in thickness. It has granular structure and is easy to work. The subsoil is grayish brown to light brownish gray and ranges from 4 to 10 inches in thickness. It contains more clay than the surface layer. Its structure is blocky. The subsoil absorbs water well and holds it. It is hard when dry and friable when moist. The underlying material consists of silty and sandy alluvium. In many places the material below a depth of 3 feet consists of interbedded layers of sand, silt, and clay. Beds of gravel occur in deep substrata.

The Fort Collins soils are associated with the Nunn soils and with Loamy alluvial land and Sandy alluvial land. The surface layer of the Fort Collins soils is lighter colored than that of the Nunn soils. The subsoil is lighter colored, contains less clay, and has weaker structure.

Fort Collins loam, 0 to 3 percent slopes (FcA).—This soil occurs mainly in long, narrow stream valleys in the northeastern part of the survey area. In a few places it occurs as broader areas. It is well drained and is medium textured or moderately fine textured.

This soil holds water well and has a good supply of plant nutrients. The hazard of erosion is slight to moderate.

Some of this soil is cultivated. The main crops are alfalfa, corn, and wheat. Most of the acreage is in grass or is in process of reverting to native vegetation. (Capability unit IVe–2, climatic zone C; Loamy Plains range site; windbreak group 1)

Gravelly Land

Gravelly land (Gr) is in undulating and rolling areas in the northeastern part of the survey area. It consists of a shallow layer of gravelly, calcareous material that shows little evidence of soil development. This material absorbs water readily, but it does not hold much water because the underlying material is coarse textured. The slope range is 3 to 15 percent. The hazard of erosion is slight or moderate. Water erosion is more likely than wind erosion.

This land type is in native range. It is not suited to cultivation. (Capability unit VIIs–2, climatic zone C; Gravel Breaks range site; windbreak group 5)

Kutch Series

The Kutch series consists of moderately deep, grayish-brown, moderately fine textured and fine textured soils of the uplands. These soils developed in material weathered from dark-colored shale. They occur mostly in the west-central and northern parts of the survey area.

The surface layer is grayish brown and ranges from 3 to 6 inches in thickness. It has very fine granular structure and is hard to work. The subsoil ranges in thickness from 12 to 16 inches. It is normally grayish brown, and it has blocky structure. This layer absorbs water slowly and is extremely hard when dry. The underlying material is dark colored and fine textured, and it contains some accumulations of gypsum and lime. Below this material is dark-colored fine sandy shale.

The Kutch soils are associated with the Christianburg, Lismas, and Renohill soils. They have a more strongly developed subsoil than the Christianburg soils, which are on terraces and fans. The Kutch soils have a thicker surface layer and subsoil than the Lismas soils and are finer textured than the Renohill soils.

Kutch clay, 1 to 5 percent slopes (KcC).—This soil is well drained and fine textured. It occurs mainly in the west-central and northern parts of the survey area. Small areas of Renohill clay loam are included in the areas mapped.

The surface layer is clay and is about 3 inches thick. The subsoil is also clay and is about 16 inches thick. It is extremely hard when dry and contains gypsum in the lower part.

Surface runoff is moderate to rapid. The hazard of erosion is slight to moderate. This soil is not suited to cultivation, because it is hard to work and takes in water slowly. Most of it is in native range. (Capability unit VIe–6, climatic zone C; Clayey Plains range site; windbreak group 5)

Kutch clay, 5 to 15 percent slopes (KcE).—This soil is mainly in the northern part of the survey area. In most places the surface layer is thinner than that of Kutch clay, 1 to 5 percent slopes, because the slopes are stronger and runoff is more rapid. Small areas of Renohill clay loam are included in the areas mapped.

Surface runoff is medium to rapid. Contour furrows, water spreaders, and diversions help to reduce runoff and control erosion.

This soil is mainly in native range. (Capability unit VIe–6, climatic zone C; Clayey Plains range site; windbreak group 5)

Kutch clay, 5 to 15 percent slopes, severely eroded (KcE3).—This soil is adjacent to Kutch clay, 5 to 15 percent slopes. The surface layer is thin, and the subsoil is exposed in places.

Part or all of the vegetative cover has been removed, and consequently, runoff is more rapid on this soil than it is on Kutch clay, 5 to 15 percent slopes. Severe sheet and gully erosion have resulted, and many of the gullies are more than 2 feet deep. (Capability unit VIIe–2, climatic zone C; Clayey Plains range site; windbreak group 5)

Lismas Series

The Lismas series consists of very shallow, clayey soils of upland slopes and breaks. These soils developed in material weathered from dark-colored, fine-textured shale. The largest tracts are north of Big Sandy Creek. A few smaller acreages occur along Horse Creek and Rush Creek in the south-central part of the survey area.

The surface layer consists of dark-colored, platy, heavy clay and ranges from 1 to 4 inches in thickness. It is underlain by 3 to 10 inches of weathered shale and shale fragments mixed with plant roots and plant residue. Below this is the parent clay shale, which is very dark gray in the northern part of the survey area and dark brown in the south-central part.

The Lismas soils are associated with the Midway, Bainville and Renohill soils. They are shallower and finer textured than the soils in the Midway–Bainville complex. They are shallower than the Kutch soils, and their subsoil is less blocky than that of the Kutch soils.

Lismas clay (5 to 15 percent slopes) (Lc).—This soil is in the northern and south-central parts of the survey area. Small tracts of Kutch and Midway soils are included in the areas mapped.

Surface runoff is medium to rapid. The hazard of erosion is slight or moderate.

All of this soil is in native range. (Capability unit VIs–2, climatic zone C; Shale Breaks range site; windbreak group 5)

Lismas clay, eroded (5 to 15 percent slopes) (Lc2).—This soil is adjacent to uneroded areas of Lismas clay. Part or all of the vegetative cover has been removed, and runoff is more rapid than it is on uneroded areas of Lismas clay. Consequently, nearly all of the surface layer has been removed, and unweathered shale is exposed in places. Rills and gullies are numerous. Many of the gullies are 2 to 6 feet deep.

This soil is used for range. Some areas can be stabilized by seeding and regulation of grazing. (Capability unit VIIe–4, climatic zone C; Shale Breaks range site; windbreak group 5)

Loamy Alluvial Land

Loamy alluvial land (Lo) consists of deep, stratified deposits of medium-textured and moderately fine textured soil material. The surface layer is brown or dark brown. The layers below it vary in texture and thickness. The underlying material ranges from sand and gravel to fine-textured shale. Horizonation is rare, and seldom does any profile resemble another, except in overall textural characteristics. The slope range is 0 to 5 percent.

This soil is friable enough to be worked easily, and it supports a good grass cover. Water erosion is a moderate to severe hazard. Wind erosion is a problem in gullied areas.

A few small areas that receive little or no damaging overflow are cultivated. Forage sorghum and wheat are the main crops. Other long, narrow areas that are along drainageways and are highly susceptible to gullying are used mainly for grazing.

Native grasses include blue grama, western wheatgrass, switchgrass, and indiangrass. (Capability unit VIw–1, climatic zone C; Overflow range site; windbreak group 4)

Midway Series

The Midway series consists of shallow upland soils that developed in material weathered from calcareous shale, fine-grained sandstone, and siltstone. These soils occur in the northeastern and north-central parts of the survey area, on sloping and moderately steep ridges.

The surface layer is light brownish-gray to grayish-brown clay loam. The subsoil is blocky clay loam. It ranges from 6 to 12 inches in thickness and overlies sandstone and shale.

Native grasses are blue grama, western wheatgrass, sideoats grama, and little bluestem.

In this survey area the Midway soils are mapped only with the Bainville or Ulm soils. They are finer textured throughout the profile than the Bainville soils.

Midway-Bainville complex (5 to 30 percent slopes) (Mb).—This complex occurs on ridges. Included in the areas mapped are small areas of Lismas and Renohill soils and a few outcrops of sandstone.

These soils are not suited to cultivation. Because of the slope, they are likely to erode. The surface layer is thin and has only a low to medium content of organic matter. A few areas have been cultivated, but most of these have been reseeded to grass. Most of the acreage is in native grass, mainly blue grama and western wheatgrass in the more nearly level areas and little bluestem and sideoats grama in the rougher areas. (Capability unit VIe–4, climatic zone C; Loamy Slopes range site; windbreak group 5)

Midway-Bainville complex, eroded (5 to 30 percent slopes) (Mb2).—This complex generally occurs within larger tracts of the uneroded Midway-Bainville complex. Most of the areas are about 20 acres in size, but a few are larger. The surface layer and much of the subsoil have been removed by water erosion and wind erosion. Gullies and rills are numerous. A few small bodies of Lismas and Renohill soils are included in the areas mapped.

This complex is used for grazing. Some has been cultivated and then abandoned. On much of the acreage the cover consists of annual and perennial weeds and such grasses as three-awn. (Capability unit VIe–5, climatic zone C; Loamy Slopes range site; windbreak group 5)

Midway-Ulm complex (5 to 30 percent slopes) (Mu).—This complex occurs mainly in the uplands north of Big Sandy Creek and south of Cedar Point in the east-central part of the survey area. A smaller area occurs in the west-central part. The Midway and Ulm soils make up about 80 percent of this complex. The Bainville, Terry, and Renohill soils make up the rest.

This complex is not suited to cultivation, because of the slope and the erosion hazard. All of the acreage is in native range. (Capability unit VIe–4, climatic zone C; Loamy Slopes range site; Midway soils are in windbreak group 5, Ulm soils are in windbreak group 1)

Midway-Ulm complex, severely eroded (5 to 30 percent slopes) (Mu3).—This complex occurs mainly within larger areas of the uneroded Midway-Ulm complex. The slope in this unit generally exceeds 25 percent. The surface layer is thin, and in many places the subsoil is exposed. Sandstone and shale crop out in some places.

Runoff is very rapid and has caused deep gullying in many places along the larger drainageways. Water erosion becomes more severe as the vegetative cover decreases.

All of this complex is in native range. Intensive grassland management is required. (Capability unit VIIe–4, climatic zone C; Shale Breaks range site; windbreak group 5)

Nunn Series

The Nunn series consists of deep and moderately deep, medium-textured and moderately fine textured soils that occupy nearly level and gently sloping stream terraces and alluvial fans. These soils developed in mixed alluvium.

The surface layer is grayish brown and ranges from 3 to 8 inches in thickness. It has granular structure and is easy to work. In most places this layer is medium textured, but some areas of these soils have received deposits of sandy material from adjacent slopes, and the surface layer in these areas is moderately coarse textured. The subsoil is blocky and moderately fine textured. It ranges from 17 to 33 inches in thickness. This layer holds water well. The underlying material is mixed alluvium of moderately fine to gravelly texture.

The Nunn soils are associated with the Fort Collins and Christianburg soils and with Loamy alluvial land and Sandy alluvial land. They are more deeply developed than the Fort Collins soils and have a finer textured subsoil.

Nunn loam, 0 to 3 percent slopes (NmA).—This soil occurs as narrow bands on stream terraces, mostly in the northern part of the survey area.

This soil takes water at a medium rate, but permeability is moderately slow in the subsoil. The water-holding capacity is medium to high, and most of the water stored is readily available to plants. Natural fertility is moderate.

Less than half of the acreage is cultivated, and the rest is in native grass. Wheat, corn, and sorghum are the main crops. (Capability unit IVe-2, climatic zone C; Loamy Plains range site; windbreak group 1)

Nunn loam, 3 to 5 percent slopes, severely eroded (NmC3).—This soil is on stream terraces, mostly in the drainageways. It has more rapid runoff than Nunn loam, 0 to 3 percent slopes, and is consequently subject to gullying and to severe sheet and rill erosion. In many places the clay loam subsoil is exposed.

Conservation devices, such as gully plugs, dams, and diversions, are needed to control erosion.

Most of this soil is in native grass. (Capability unit VIe-3, climatic zone C; Loamy Plains range site; windbreak group 1)

Nunn sandy loam, 0 to 3 percent slopes (NnA).—This soil is mostly in the northern part of the survey area. The surface layer is sandy loam.

This soil takes water readily and has good water-holding capacity. Because it has a sandy surface layer, it is susceptible to wind erosion when cultivated.

Stubble mulching, protection of the natural waterways with grass cover, and the use of close-growing crops help to control wind and water erosion and to conserve moisture. (Capability unit IVe-4, climatic zone C; Loamy Plains range site; windbreak group 1)

Platner Series

In the Platner series are deep and moderately deep soils of the uplands. They developed in sandy and loamy outwash material that contains some gravel. These soils occur mainly in the central and southeastern parts of the survey area.

The surface layer is grayish-brown to brown platy or granular loam. It ranges from 2 to 10 inches in thickness but commonly is about 7 inches thick. The subsoil is brown or yellowish-brown clay loam. It ranges from 10 to 18 inches in thickness but generally is about 12 inches thick. It has a blocky structure and is hard when dry. This layer takes water slowly but holds it well. The underlying material is light yellowish-brown, highly calcareous sandy loam.

These soils are soft and rather easy to work. They will blow and wash if not protected.

The Platner soils are associated with the Ascalon and Stoneham soils. They contain much more clay and less sand than the Ascalon soils. Their subsoil is more clayey and more blocky than that of the Stoneham soils. The Platner soils are less silty than the Weld soils, and they contain more sand and fine gravel than those soils.

Platner loam, 0 to 1 percent slopes (PmA).—This soil occurs mainly in the south-central part of the survey area. In many places the profile is thicker than is typical of the series. Small areas of Stoneham loam are included in the areas mapped.

Surface runoff is slow. The hazard of erosion is slight.

Nearly all of this soil is cultivated. Wheat is the principal crop, but some sorghum is grown. (Capability unit IVe-2, climatic zone C; Loamy Plains range site; windbreak group 1)

Platner loam, 1 to 3 percent slopes (PmB).—This soil occurs throughout the central and southeastern parts of the survey area. Small tracts of Stoneham and Ascalon soils are included in the areas mapped.

Surface runoff is low or medium, and the hazard of erosion is slight to moderate. Stubble mulching, stripcropping, and the use of broad-based terraces help to conserve moisture and control wind erosion. During dry years emergency tillage for control of blowing is often necessary.

Most of this soil is cultivated. Wheat is the major crop, but sorghum and barley are also grown. (Capability unit IVe-2, climatic zone C; Loamy Plains range site; windbreak group 1)

Platner loam, 3 to 5 percent slopes (PmC).—This soil occurs in the central and southeastern parts of the survey area. It has a thinner surface layer and subsoil than Platner loam, 1 to 3 percent slopes. Areas of Stoneham and Ascalon soils are included in some of the areas mapped.

Surface runoff is medium, and the hazard of erosion is moderate. Stubble mulching, stripcropping, and terracing help to conserve moisture and control erosion.

Most of this soil is cultivated. Wheat is the main crop, but sorghum and barley are also grown. (Capability unit IVe-3, climatic zone C; Loamy Plains range site; windbreak group 1)

Platner loam, 5 to 9 percent slopes (PmD).—This soil occurs along drainageways in the south-central part of the survey area. The surface layer is loamy and is about 3 inches thick. The subsoil is about 10 inches thick. Some areas of Ascalon sandy loam and Stoneham sandy loam are included in the areas mapped.

Surface runoff is medium or rapid, and there is a moderate hazard of erosion. Consequently, this soil is not suited to cultivation. A few fields that were formerly cultivated have been reseeded to grass. (Capability unit VIe-3, climatic zone C; Loamy Plains range site; windbreak group 1)

Platner-Ascalon sandy loams, 0 to 3 percent slopes (PsB).—The soils in this mapping unit are so intermingled that it was not practical to map them separately. Some areas of Stoneham soils are included in the areas mapped.

All of the acreage has been slightly to moderately eroded by wind. Wind erosion has mixed topsoil with other material, and consequently the surface layer is loamy sand in places.

Most of the acreage is cultivated, but some areas in the drier southeastern part of the survey area are still in native grass. A few fields in the southeastern part have been abandoned or have been reseeded to grass. Winter wheat, grain sorghum, and forage sorghum are the main crops. Grasses that will grow on sandy land are dominant in areas used for range. (Capability unit IVe–5, climatic zone C; Sandy Plains range site; windbreak group 3)

Platner-Ascalon sandy loams, 3 to 5 percent slopes (PsC).—The proportion of Ascalon soils is slightly greater in this mapping unit than in Platner-Ascalon sandy loams, 0 to 3 percent slopes, and inclusions of Stoneham soils make up a larger proportion of the acreage. Both the surface layer and the subsoil are thinner than those of the nearly level soils.

The hazard of erosion is slight to moderate. Water erosion is a greater hazard than on the less sloping phases of Platner-Ascalon sandy loams.

Most of the acreage is in native grass, but some is cultivated. Wheat and forage sorghum are the main crops. Native grasses include sandreed, sand bluestem, sand dropseed, and blue grama. (Capability unit IVe–6, climatic zone C; Sandy Plains range site; windbreak group 3)

Renohill Series

The Renohill series consists of deep and moderately deep soils of gently sloping to moderately steep uplands. These soils are moderately fine textured, and the lower part of their profile is calcareous in most places. The soils developed in material weathered from shale and modified by alluvium carried by runoff.

The surface layer is grayish brown and ranges from 3 to 5 inches in thickness. It is medium textured or moderately fine textured. The subsoil ranges from 8 to 18 inches in thickness. It has a blocky structure and holds water well. When dry, it is very hard. The underlying shale is mottled in many places.

The Renohill soils are associated with the Lismas, Midway, and Ulm soils. The Renohill soils are deeper over shale than the Midway soils. The Renohill subsoil contains more clay than the surface layer, and in this respect these soils differ from the Midway soils. Also, the Renohill soils have a more strongly developed subsoil than the Midway soils. They contain more silt than the Ulm soils and have a coarser structure.

Renohill clay loam (Rc).—This soil occurs mainly in the northeastern and northwestern parts of the survey area. The surface layer is thin on the steeper slopes, and there are small outcrops of shale. Small areas of Lismas, Midway, and Ulm soils are included in the areas mapped.

Surface runoff is medium or rapid. The hazard of erosion is moderate. Most of this soil is in native range. It is not suited to cultivation, because it is steep, is fine textured, and takes water slowly. Most of the formerly cultivated areas of this soil have been abandoned or have been reseeded to grass. (Capability unit VIe–6, climatic zone C; Clayey Plains range site; windbreak group 5)

Renohill complex, 3 to 15 percent slopes, eroded (ReE2).—This complex is adjacent to or within larger areas of Renohill clay loam. In many places the surface layer has been removed by erosion and the subsoil is exposed. Gullies and rills are numerous.

This complex is suited to only limited grazing because the grass cover is sparse and erosion is a hazard. Some fields were formerly cultivated but have been abandoned. (Capability unit VIIe–2, climatic zone C; Clayey Plains range site; windbreak group 5)

Riverwash

Riverwash (Rh) consists of areas of alluvial sand and gravel in which there are streaks and pockets of silt and clay. It is light colored in most places and generally barren of vegetation. Cottonwood seedlings and small tufts of grass grow in scattered spots. Riverwash is subject to scouring and receives fresh deposits of alluvium from floodwaters. None of this land type is suitable for agriculture. (Capability unit VIIIs–1, climatic zone C; windbreak group 5)

Rough Broken Land

Rough broken land (Rn) occurs between tablelands in the northeastern part of the survey area. The slope range is 10 to 40 percent, and the hazard of water erosion is moderate to severe. The underlying material is the kind from which shallow, sandy, and clayey soils generally develop, but because of the rough topography, little soil development has taken place.

All of this land type is too steep, too rocky, or too shallow for cultivation. Some of it can be used to a limited extent for grazing, but about 40 percent consists of barren rock or shale or is too steep to be of use even for grazing. The lesser slopes have a fair to good cover of western wheatgrass, blue grama, sideoats grama, and little bluestem. Some pinyon pine grows in the broken sandstone areas. (Capability unit VIIs–3, climatic zone C; Shale Breaks range site; windbreak group 5)

Rough Gullied Land

Rough gullied land (Ro) occurs in the northeastern part of the survey area, at the head of drainageways. The soils of these areas formed in loess deposited over soft, fine-grained sandstone, but now the areas consist almost entirely of active gullies 3 to 80 feet deep. Some of the gullies extend through the sandstone into the underlying heavy shale.

Cottonwood trees and small shrubs have been planted in attempts to control erosion. Grama grasses are slowly becoming established around the upper edges of gullies and on some of the ridges between gullies. (Capability unit VIIIe–3, climatic zone C; windbreak group 5)

Sandy Alluvial Land

Sandy alluvial land (Sa) occurs in association with Loamy alluvial land on slightly elevated flood plains along the major streams and smaller drainageways in the survey area. It is flooded periodically and receives deposits of sand or silt frequently. Although highly stratified as a result of these deposits, it has a loamy sand or sand texture in most places. The uppermost 2 or 3 inches of the surface layer is usually darkened as a result of the decaying of surface litter, but the underlying material is light colored.

None of this soil is suitable for cultivation. It is used mainly as grazing land. The water table is so low that plants do not benefit from it. Most of the acreage has a cover of grass and cottonwood trees, but some areas are barren. Native grasses include switchgrass, sand bluestem, little bluestem, big bluestem, indiangrass, and sandreed. (Capability unit VIw–1, climatic zone C; Overflow range site; windbreak group 4)

Slickspot-Kutch Complexes

The Kutch soils in these complexes are like those described as typical of the Kutch series. They are less extensive than the Slickspot land type but are more important agriculturally. Slickspots have a thin, grayish surface layer. In many places the hard, compact, clayey subsoil is exposed.

Slickspot-Kutch complex, 3 to 9 percent slopes (SkD).—All of this complex is in range. The native grasses include western wheatgrass, alkali sacaton, and blue grama. A few scattered fields were formerly cultivated but have been abandoned. On the Slickspot soils the vegetative cover is sparse or lacking. The hazard of erosion is slight to moderate. (Capability unit VIe–7, climatic zone C; Slickspot part is in Salt Flats range site and Kutch part is in Clayey Plains range site; windbreak group 5)

Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded (SkD3).—This complex is associated with Slickspot-Kutch complex, 3 to 9 percent slopes. The vegetative cover has been depleted, and runoff has resulted in severe sheet erosion and in the formation of deep gullies in swales and drainageways.

This soil loses a large amount of water through runoff. Therefore, intensive practices designed to reduce runoff and give protection from further erosion are needed. Complete exclusion of grazing animals is the best way to restore the vegetative cover and to halt active erosion. (Capability unit VIIe–2, climatic zone C; Slickspot part is in Salt Flats range site and Kutch part is in Clayey Plains range site; windbreak group 5)

Stoneham Series

In the Stoneham series are moderately deep, sandy and loamy soils (fig. 3). These soils occur throughout the survey area, but they are most common in the central, southern, and eastern parts. They developed in calcareous, sandy and gravelly material. The upper horizons contain varying amounts of wind-deposited silty material.

The surface layer is light brownish-gray sandy loam or loam that has a fine granular structure. It ranges from 3 to 8 inches in thickness but most commonly is about 6 inches thick. The subsoil is light brownish-gray to pale-brown, blocky, heavy loam or light clay loam. It is 6 to 11 inches thick but generally about 8 inches. This layer takes and holds water fairly well. The underlying material is typically pale-brown or yellowish-brown sandy or limy material that seldom receives much moisture. In places this material rests on consolidated or partly weathered coarse sandstone.

These soils are easy to work, but they blow readily if they are not protected.

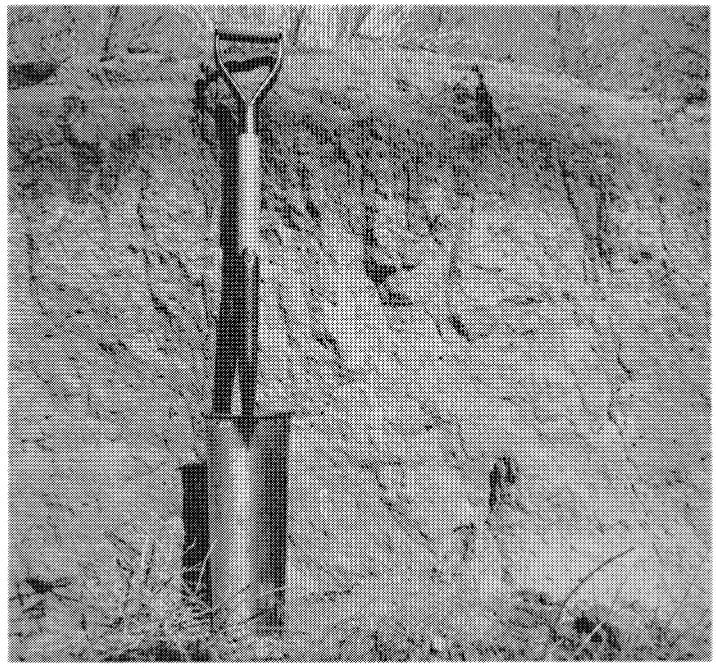

Figure 3.—**Profile of Stoneham sandy loam.**

The Stoneham soils are associated with the Ascalon and Platner soils. Their subsoil contains more silt and clay and less sand than that of the Ascalon soils. The Stoneham soils are more sandy and less clayey than the Platner soils.

Stoneham loam, 1 to 3 percent slopes (SmB).—This soil is mainly in the southern part of the survey area. The surface layer is about 6 inches thick. The subsoil is loam or clay loam and is about 11 inches thick. Small areas of Platner soils are included in the areas mapped.

Most of this soil is cultivated. Wheat is the principal crop, but sorghum and barley are also grown. Surface runoff is slow, and the hazard of erosion is slight. Terracing and stubble mulching help to control erosion and conserve moisture. (Capability unit IIIc–1 if in climatic zone B, and IVe–2 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Stoneham loam, 3 to 5 percent slopes (SmC).—This soil is mainly in the southern part of the survey area. The surface layer is loam and is about 4 inches thick. The subsoil is loam or clay loam and is about 9 inches thick. Small areas of Ascalon soils are included in the areas mapped.

This soil is easy to work. Its water-holding capacity is good, and its natural fertility is moderate. Surface runoff is medium, and the hazard of erosion is slight or moderate.

Most of the acreage is cultivated. Wheat, sorghum, and barley are the principal crops. (Capability unit IIIe–1 if in climatic zone B, and IVe–3 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Stoneham sandy loam, 1 to 5 percent slopes (SnC).—This soil is mainly in the central and southeastern parts of the survey area. The surface layer is sandy loam and is about 6 inches thick. The subsoil is loam and is about 10 inches thick. Small areas of Platner and Ascalon soils are included in the areas mapped.

Most of the acreage is cultivated. Wheat and forage sorghum are the main crops, but barley and field corn are also grown. Surface runoff is slow or medium, and the hazard of erosion is slight or moderate. Terracing, stripcropping, stubble mulching, and the use of close-growing crops help to control erosion and conserve moisture. (Capability unit IVe-6, climatic zone C; Sandy Plains range site; windbreak group 3)

Stoneham sandy loam, 5 to 18 percent slopes (SnE).—This soil occurs along most of the major drainageways throughout the survey area, but it is mainly in the south-central part. Both the surface layer and the subsoil are thinner than those of Stoneham sandy loam, 1 to 5 percent slopes. Small areas of Ascalon soils and of Gravelly land are included in the areas mapped.

This soil is well suited to grass and is used as native range. It is susceptible to wind and water erosion and consequently needs management that will prevent overgrazing and encourage the growth of desirable grasses. (Capability unit VIe-1, climatic zone C; Sandy Plains range site; windbreak group 3)

Stoneham complex, 1 to 5 percent slopes, eroded (StC2).—This complex occurs within and adjacent to areas of Stoneham sandy loam. Wind erosion and water erosion have removed all of the surface layer. In many places the subsoil also has been removed by erosion, and the underlying limy material is at the surface. There are many gullies, rills, and hummocks.

These soils need to be smoothed and graded and then reseeded to grass. After grass has become established, overgrazing must be prevented.

These soils were formerly used mainly for wheat and sorghum, but most of the cultivated fields have been abandoned or have been reseeded to grass. (Capability unit VIe-2, climatic zone C; Sandy Plains range site; windbreak group 3)

Terry Series

The Terry series consists of deep and moderately deep, sandy soils of the uplands. These soils developed in sandy material. They occur mainly in the northern half of the survey area.

The surface layer is thin, light colored, and moderately coarse textured. It is granular and soft. The subsoil is fine sandy loam, loam, or light sandy clay loam. It has a weak structure. When dry it is hard enough to be difficult to dig. The underlying material is calcareous fine sandy loam that ranges from 3 feet to many feet in thickness. Below is soft, fine-grained sandstone.

These soils are not suitable for cultivation, because the texture is sandy and the slopes are irregular and, in places, steep. The hazard of wind erosion is severe if there is no plant cover.

The Terry soils are associated with the Ulm and Midway soils. They are coarser textured than the Ulm soils and have a less well defined structure. They are less deep than the Vebar soils, contain more lime, and have a lighter colored surface layer.

Terry fine sandy loam, 5 to 20 percent slopes (TaE).—This soil is in the northern half of the survey area where the slopes are rolling and moderately steep. Small areas of Ulm and Vebar soils are included in the areas mapped.

If a good grass cover is maintained, the hazard of erosion is slight to moderate. If the grass cover is depleted the hazard of erosion is severe because of the slope and the sandy texture.

This soil is in native vegetation and is not suited to cultivation. Good range management is needed to prevent overgrazing. (Capability unit VIe-1, climatic zone C; Sandy Plains range site; windbreak group 3)

Terry-Lismas complex (5 to 20 percent slopes) (Tc).—This complex occurs on uplands in the north-central and northwestern parts of the survey area. Small areas of Ulm, Midway, Kutch, and Tullock soils are included in the areas mapped.

All of this complex is in native range. The erosion hazard is slight to moderate. Management that will prevent overgrazing is necessary. (Capability unit VIs-3, climatic zone C; Terry part is in Sandstone Breaks range site and in windbreak group 3; Lismas part is in Shale Breaks range site and in windbreak group 5)

Terry-Lismas complex, severely eroded (5 to 20 percent slopes) (Tc3).—This complex occurs within and adjacent to uneroded areas of Terry-Lismas complex.

In most places the surface layer has been removed and the subsoil is exposed. In many places the underlying shale and sandstone are exposed. Gullies and rills are numerous.

These soils are used as range along with the surrounding soils. They are in critical condition and require intensive conservation treatment. Exclusion of grazing animals is necessary to allow vegetation to become reestablished in actively eroding areas. (Capability unit VIIe-3, climatic zone C; Terry part is in Sandstone Breaks range site; Lismas part is in Shale Breaks range site; windbreak group 5)

Terry-Vebar-Tullock complex, 5 to 25 percent slopes (TeE).—This complex occurs on uplands in the north-central part of the survey area. Small areas of Lismas and Ulm soils are included in the areas mapped.

All of this complex is in native range. Grasses include sand bluestem, big bluestem, little bluestem, sandreed, sideoats grama, needle-and-thread, and Indian ricegrass. These soils are moderately susceptible to erosion and consequently need management that will prevent overgrazing and encourage the growth of desirable grasses. (Capability unit VIe-10, climatic zone C; Terry part is in Sandy Plains range site; Vebar part is in Deep Sand range site; Tullock part is in Sandstone Breaks range site; windbreak group 2)

Truckton Series

The Truckton series consists of upland soils that are deep or moderately deep and moderately coarse textured (fig. 4). Typically, these soils are noncalcareous, but in a few small areas they are slightly calcareous. They developed in eolian arkosic sand. They occur mainly in the western part of the survey area.

The surface layer is grayish brown. It ranges from 4 to 8 inches in thickness. It has a granular structure. The subsoil contains more clay than the surface layer. It ranges from 12 to 25 inches in thickness and has a blocky structure. This layer absorbs and holds water moderately well, but it becomes very hard when dry.

These soils are easy to work. If cultivated they need a plant cover at all times for control of erosion.

Figure 4.—**Profile of Truckton sandy loam.**

The Truckton soils are associated with the Blakeland and Bresser soils. They have a finer textured subsoil than the Blakeland soils. They are coarser textured than the Bresser soils.

Truckton sandy loam, 1 to 3 percent slopes (TkB).—This soil occurs mainly along the western side and in the central part of the survey area. The surface layer is sandy loam and is about 8 inches thick. In a few places wind erosion has removed part of the surface layer. In these spots the surface layer is thin, and in some it is coarser textured than in the uneroded areas. The subsoil is sandy loam or sandy clay loam and is about 25 inches thick. Small areas of Bresser sandy loam are included in the areas mapped.

This soil is easy to work. It absorbs and holds water moderately well.

Most of the acreage is cultivated. Wheat and sorghum are the principal crops. Wind erosion is a serious problem at times because the surface layer is coarse textured and the climate is dry. Enough crop residue must be left on the surface to protect the soil from blowing. (Capability unit IVe–5, climatic zone C; Sandy Grassland range site; windbreak group 3)

Truckton sandy loam, 3 to 5 percent slopes (TkC).—This soil occurs in the uplands, mainly in the western and central parts of the survey area.

The surface layer is sandy loam and is about 5 inches thick. Wind erosion has removed part or all of the surface layer from a few small areas. The subsoil is sandy loam or sandy clay loam and is about 18 inches thick. Small areas of Bresser and Blakeland soils are included in the areas mapped.

This soil is not suited to cultivation, because it is highly susceptible to wind and water erosion. It is suitable for range, but good management is needed to prevent overgrazing and to protect the soil from erosion. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 3)

Truckton sandy loam, 5 to 20 percent slopes (TkE).—This soil occurs in the uplands in the western and central parts of the survey area. The surface layer is thinner and somewhat coarser textured than that of the less sloping Truckton soils. The subsoil is generally sandy loam and is about 12 inches thick. Small areas of Blakeland soils are included in the areas mapped.

This soil is not suited to cultivation. Most of it is in native range. The hazard of erosion is slight to moderate. Care must be taken to prevent overgrazing. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 3)

Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded (TrE2).—The soils in this undifferentiated unit are so intermixed that it was not feasible to map them separately. They occur in the uplands, mainly in the western and central parts of the survey area. These soils lie within or adjacent to larger areas of Truckton sandy loam. Wind erosion and water erosion have removed all or nearly all of the surface layer. The texture of the present surface layer ranges from loamy sand to sandy clay loam. Gullies, rills, and hummocks are numerous.

These soils need to be smoothed and graded to prepare a seedbed for grass. Small grain or sorghum should be drilled to provide protective stubble in which to drill grass seed. Grazing should be deferred until grass is well established.

Some of the acreage was formerly cultivated but has now been abandoned. Some fields have been reseeded to grass. (Capability unit VIe–9, climatic zone C; Sandy Grassland range site; windbreak group 3)

Tullock Series

In the Tullock series are shallow and very shallow soils. These soils occupy high knolls and sharp ridgetops and occur almost entirely in the northwestern and north-central parts of the survey area. They developed in mildly calcareous, fine-grained sandstone and siltstone.

The surface layer is light brownish-gray loamy fine sand. It ranges from 3 to 10 inches in thickness but most commonly is about 4 inches thick. The underlying material is loamy fine sand or very fine sand that ranges from pale brown or light gray to brown in color. This layer takes in water rapidly but does not hold it very long. The parent rock is moderately hard shaly sandstone and interbedded shale that is fractured and partly weathered in places. The colors are predominantly brown, gray, and rust.

These soils normally have a good or fair cover of mid grasses and shrubs, which holds the soil material in place. The surface layer blows easily if it is not protected by a cover of plants. Many areas are eroded.

In this survey area the Tullock soils occur only in small tracts, and it was not feasible to map them separately. They are mapped with the Vebar and Terry soils.

Ulm Series

The Ulm series consists of moderately deep and deep, moderately fine textured and medium-textured soils of the uplands. These soils occur in the northern

part of the survey area. They developed in material weathered from fine-grained sandstone and siltstone.

The surface layer is grayish brown and ranges from 3 to 7 inches in thickness. It is granular and medium textured. The subsoil is grayish brown to pale brown and ranges from 30 to 45 inches in thickness. It is blocky and moderately fine textured. The subsoil absorbs and holds water well, but it is hard when dry. The underlying material is moderately coarse textured to moderately fine textured. In a few places it is underlain at a depth of 30 inches or more by fine-grained sandstone, siltstone, or fine-grained sandy shale.

These soils are easy to work, but they need a cover of plants to keep them from blowing.

The Ulm soils are associated with the Renohill, Midway, and Terry soils.

Ulm loam, 1 to 5 percent slopes (UaC).—This soil occurs in the northern part of the survey area. The surface layer is about 6 inches thick. The subsoil is clay loam and is about 40 inches thick. Small tracts of Renohill, Midway, and Bainville soils are included in the areas mapped.

This soil is easy to work. It takes in water well, and its water-holding capacity is good. Surface runoff is slow to medium, and the hazard of water erosion is slight to moderate. This soil is highly susceptible to wind erosion if not protected by growing crops or stubble. Terracing, stubble-mulching, and stripcropping help to conserve moisture and control erosion.

Most of this soil is cultivated. Wheat is the main crop, but barley and forage crops are also grown. (Capability unit IVe-3, climatic zone C; Loamy Plains range site; windbreak group 1)

Ulm loam, 5 to 12 percent slopes (UaD).—This soil occurs in the northern part of the survey area. The surface layer is about 3 inches thick. The subsoil is clay loam and is about 30 inches thick. Small areas of Terry, Midway, and Bainville soils are included in the areas mapped, and also a few outcrops of sandstone.

Surface runoff is medium or rapid. The hazard of erosion is moderate.

Nearly all of this soil is in native range. (Capability unit VIe-4, climatic zone C; Loamy Slopes range site; windbreak group 1)

Ulm loam, 5 to 12 percent slopes, severely eroded (UaD3).—This soil occurs within or adjacent to larger areas of other Ulm loams. The surface layer has been thinned or removed by erosion, and the subsoil is exposed in many places. Small areas of Renohill, Terry, and Midway soils are included in the areas mapped. Rills and deep gullies are numerous.

Some of this soil was formerly cultivated, but most of the fields have been abandoned. These old fields are so badly gullied that reseeding is not feasible. Plant cover can be reestablished in areas where erosion is active only by completely excluding grazing animals. After grass has been established, overgrazing must be prevented if erosion is to be controlled. (Capability unit VIIe-1, climatic zone C; Loamy Slopes range site; windbreak group 1)

Ulm-Beckton complex, 3 to 9 percent slopes (UbD).—This complex occurs mainly in the north-central part of the survey area.

Surface runoff is rapid. The hazard of erosion is moderate, and water erosion is more likely than wind erosion.

Nearly all of this complex is in grass; none of it is suitable for crops. (Capability unit VIe-7, climatic zone C; Ulm part is in Loamy Plains range site and in windbreak group 1; Beckton part is in Salt Flats range site and in windbreak group 5)

Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded (UbE3).—The proportion of Beckton soils is smaller in this complex than in Ulm-Beckton complex, 3 to 9 percent slopes. In many places the underlying sandstone and shaly material is exposed. Rills and gullies are numerous. Many of the gullies are too deep to be crossed with machinery.

Surface runoff is rapid because of the slope and the sparseness of the plant cover. The hazard of sheet erosion is severe.

This complex should be reseeded where possible. Reseeding is best accomplished by completely excluding grazing animals. Hand broadcasting of seed may be necessary if too few seed plants are present. After a stand of grass has been established, overgrazing must be prevented if erosion is to be controlled. (Capability unit VIIe-1, climatic zone C; Loamy Slopes range site; windbreak group 5 (both soils))

Vebar Series

The Vebar series consists of moderately deep and deep soils of the uplands. These soils occur in the north-central part of the survey area. They developed in fine sandy valley fill.

The surface layer is grayish-brown loamy fine sand and is 8 to 12 inches thick. It has fine granular texture and is easy to work. It blows easily if not protected. This layer takes water rapidly. The subsoil is brown light fine sandy loam or loamy fine sand. It is soft and blocky and is 10 to 22 inches thick. It takes water readily but does not hold much. The underlying material is light yellowish-brown fine sand.

The Vebar soils are associated with the Terry, Tullock, and Ulm soils. They are not so limy as the Terry soils. Their subsoil contains more fine-grained sand than that of the Truckton soils, and it is not so sticky as the Truckton subsoil. The Vebar soils contain more fine sand and less coarse sand than the Blakeland soils.

Vebar loamy fine sand, 3 to 5 percent slopes (VbC).—This soil occurs in the north-central part of the survey area. Small tracts of Terry and Tullock soils are included in the areas mapped.

This soil is not suitable for cultivation, and most of it is in native grass. A few small fields are used for feed crops, such as sorghum and sudangrass, but growing crops is hazardous because the soil is subject to severe wind erosion if it is not protected by plant cover. Good range management is necessary to prevent overgrazing and to control erosion. (Capability unit VIe-8, climatic zone C; Deep Sand range site; windbreak group 2)

Vebar loamy fine sand, 5 to 20 percent slopes (VbE).—This soil occurs in areas where the slopes are rolling or moderately steep. The surface layer is thinner and somewhat coarser textured than the surface layer of Vebar loamy

fine sand, 3 to 5 percent slopes. In a few small areas, wind erosion has caused the formation of dunelike topography. Small tracts of Terry and Tullock soils are included in the areas mapped.

This soil is not suitable for cultivation, and most of it is in native grass. A few small fields, which were formerly cultivated, have been severely eroded by wind and are now abandoned. Good range management is necessary to prevent overgrazing and to control erosion. (Capability unit VIe–8, climatic zone C; Deep Sand range site; windbreak group 2)

Weld Series

In the Weld series are deep and moderately deep, loamy soils (fig. 5) of the uplands. These soils occur in a spotty pattern in the survey area. They are most extensive in the west-central part of the survey area and on Cedar Point in the northeastern part. They developed in highly calcareous, silty, wind-deposited material.

The surface layer is dark grayish-brown loam or silt loam that is 3 to 7 inches thick. It is soft and granular and easy to work. The subsoil is brown to grayish-brown, blocky silty clay loam or silty clay. It is 12 to 25 inches thick and is slowly permeable to water. The underlying material is light brownish-gray silt loam that is highly calcareous. In places material weathered from the local sandstone and shale is mixed with the silt loam.

The Weld soils are associated with the Wiley, Colby, and Baca soils. They are more clayey throughout than the Wiley soils, and they have less lime in their surface layer and in their subsoil than those soils. They are darker colored than the Baca soils, they are deeper to lime, and they have a thicker subsoil.

Weld loam, 0 to 1 percent slopes (WaA).—This soil is mainly in the west-central part of the survey area. It occupies swales and flat upland benches. The surface layer is about 6 inches thick. The subsoil is silty clay loam or silty clay and is about 25 inches thick. In many places the surface layer and the subsoil are darker than those of the Weld soils in steeper areas.

Surface runoff is slow, and the hazard of erosion is slight. Stubble mulching helps to conserve moisture and control wind erosion.

Most of the acreage is cultivated. Wheat is the main crop, but sorghum is also grown. (Capability unit IIIc–1 if in climatic zone B, and IVe–2 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Weld loam, 1 to 3 percent slopes (WaB).—This soil occupies benches and ridges on the uplands. It occurs in all areas where the Weld soils are mapped. Small areas of Baca soils are included in the areas mapped.

This soil is easy to work. It takes water readily, and its capacity to hold water is good. Surface runoff is slow or medium. The hazard of erosion is slight or moderate. Terracing, stubble mulching, and stripcropping help to control erosion and conserve moisture. This soil is suited to cultivation. Wheat is the main crop, but barley and sorghum are also grown. (Capability unit IIIc–1 if in climatic zone B, and IVe–2 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Weld loam, 3 to 5 percent slopes (WaC).—This soil is on the gently sloping uplands. Small areas of Baca and Wiley soils are included in the areas mapped.

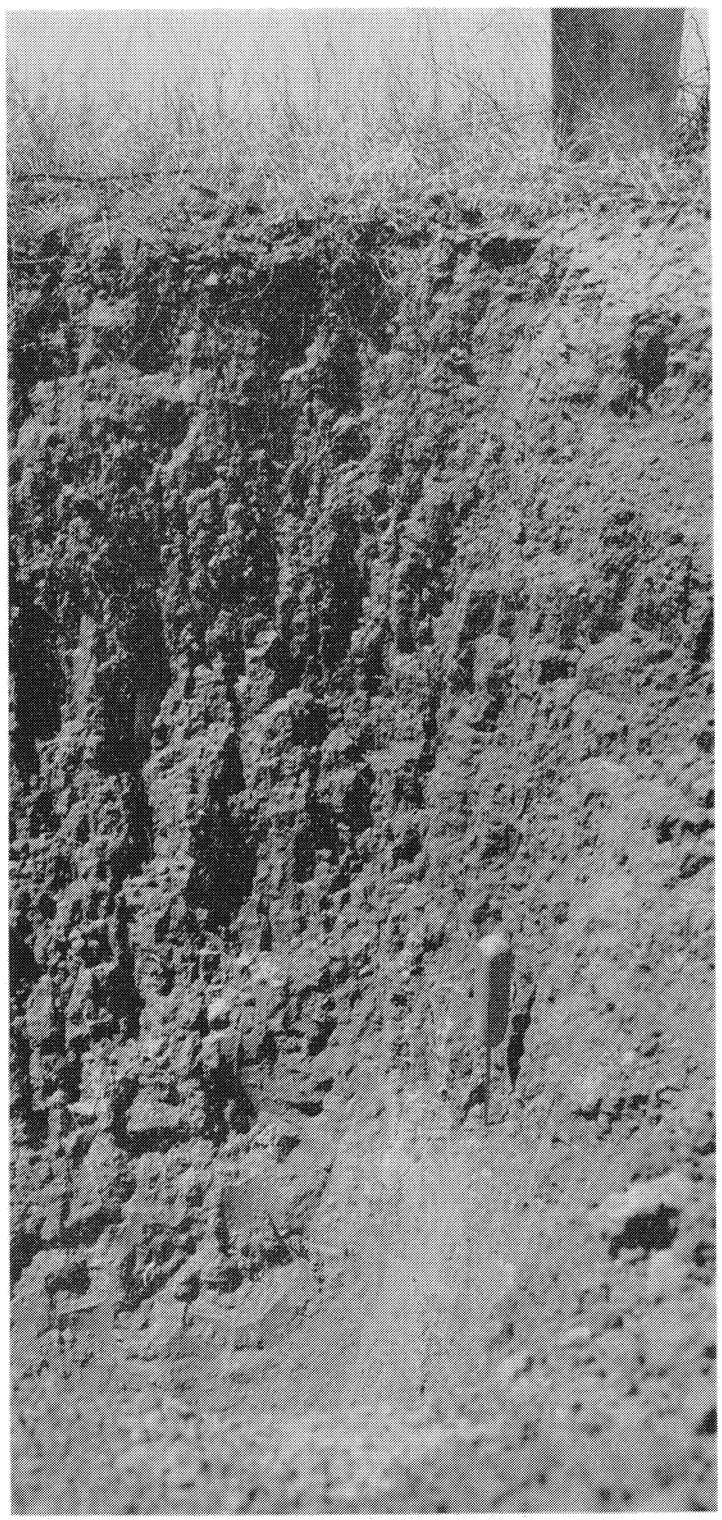

Figure 5.—**Profile of Weld loam.**

This soil is more susceptible to wind and water erosion than Weld loam, 1 to 3 percent slopes. Terracing, stubble mulching, stripcropping, and the use of diversions and grassed waterways help to control erosion and conserve moisture. Surface runoff is medium. Most of the acreage is cultivated. A few areas are in grass. (Capability

unit IIIe-1 if in climatic zone B, and IVe-3 if in climatic zone C; Loamy Plains range site; windbreak group 1)

Wet Alluvial Land

Wet alluvial land (Wb) is on the bottom lands along major streams. The surface layer consists of moderately sandy alluvium of fairly uniform texture. It overlies river sand and gravel. The slope range is 0 to 1 percent. The hazard of erosion is slight or moderate, but at times an overflow deposits a damaging amount of silt, sand, and woody debris in the lower lying areas. The water table is high throughout the growing season.

Most of this land type is too low to make drainage and cultivation feasible. Most of the areas that are high enough to be drained are so small that drainage is not economical.

Little of the acreage is used for cultivated crops. In a few places cultivated crops have been grown, but these areas have been reseeded to grass, clover, and alfalfa. Grass responds well to the plentiful moisture, and good cuttings of grassy hay are obtained. Some of the areas are used for pasture.

Native grasses include switchgrass, big bluestem, indiangrass, prairie cordgrass, and sandreed. (Capability unit Vw-1, climatic zone C; Sandy Meadow range site; windbreak group 4)

Wiley Series

In the Wiley series are deep, loamy and silty soils (fig. 6) of the uplands. These soils occupy rounded ridgetops and sloping areas in the northwestern part of the survey area. They developed in calcareous, eolian deposits.

The surface layer is light brownish-gray, fine granular loam. It ranges from 2 to 4 inches in thickness but most commonly is about 3 inches thick. The subsoil is light yellowish-brown light clay loam or loam. It has a weak, blocky structure. It ranges from 10 to 23 inches in thickness but is about 8 inches thick in most places. This layer holds a moderate amount of water, and it is only slightly hard when dry. The subsoil is underlain by light yellowish-brown, loamy, wind-deposited material that is many feet thick.

These soils are easy to work, but they blow readily if not protected.

The Wiley soils are associated with the Colby, Baca, and Weld soils. They have a blockier, more clayey subsoil than the Colby soils. The Wiley soils have less clay and more lime in the subsoil than the Baca and Weld soils. The Baca and Weld soils have smoother slopes than the Wiley soils. In this survey area the Wiley soils are mapped only with the Colby soils.

Wiley and Colby soils, 3 to 5 percent slopes (WcC).—This undifferentiated unit occurs in the uplands, mostly in the northwestern part of the survey area. A few small tracts are on Cedar Point. The Wiley soils make up the larger part of this unit. Wind erosion has removed most of the surface layer from a few small areas and, in places, much of the subsoil. Small tracts of Baca soils are included in the areas mapped.

Surface runoff is medium to rapid, and the hazard of water erosion is moderate. The hazard of wind erosion

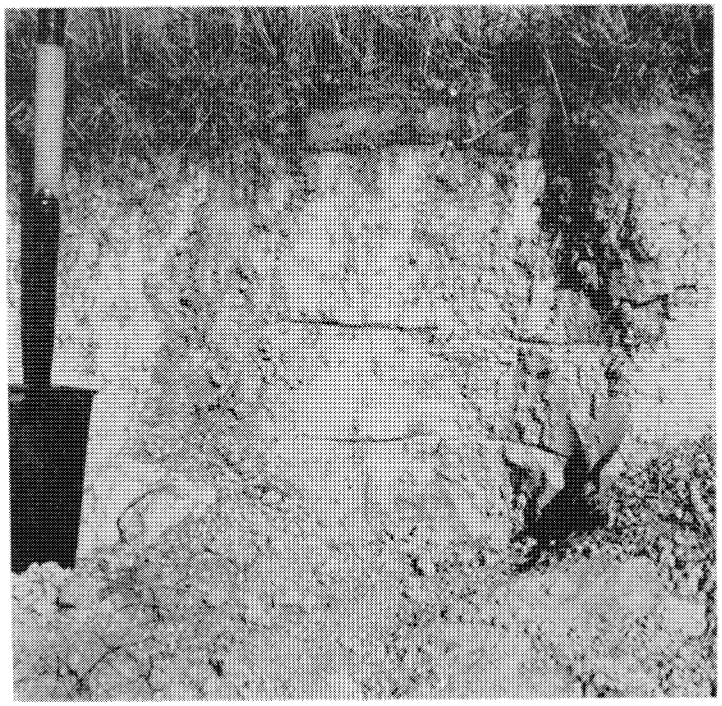

Figure 6.—Profile of Wiley loam.

is severe if the grass cover is depleted. Consequently, good range management is necessary.

This unit is not suitable for cultivation, and most of it is in grass. Most of the eroded areas were formerly cultivated but were abandoned. Some of the fields have been reseeded to grass. (Capability unit VIe-3, climatic zone C; Loamy Plains range site; windbreak group 1)

Wiley and Colby soils, 5 to 18 percent slopes (WcE).—This undifferentiated unit occurs mostly in the northwestern part of the survey area. The surface layer of these soils is thinner than that described as typical of the series. In a few places wind erosion and water erosion have removed all of the surface layer. Gully erosion is severe in some places. Small tracts of Baca soils are included in the areas mapped.

Surface runoff is rapid, and much of the rainfall is lost.

This unit is not suitable for cultivation; most of it is in grass. A few small fields were formerly cultivated but have been abandoned. Good range management is necessary to prevent overgrazing and to control erosion (Capability unit VIe-4, climatic zone C; Loamy Slopes range site; windbreak group 1)

Yoder Series

The Yoder series consists of gravelly, noncalcareous soils. These soils occur on ridges and on the crest of high terraces. They developed in gravelly material.

The surface layer is grayish brown and about 4 inches thick. In most places the uppermost 2 inches of the surface layer is gravelly loamy sand, but the lower part is gravelly sandy loam. The subsoil is brown and more clayey than the surface layer. It ranges from 6 to 10 inches in thickness. The underlying material is generally clean sand and gravel. The water-holding capacity of these soils is very low.

The Yoder soils are associated with the Bresser, Truckton, and Blakeland soils. They are thinner than the Blakeland soils and contain more gravel than those soils.

Yoder gravelly sandy loam (5 to 25 percent slopes) (Yg).—This soil occurs on ridges and on the crest of high terraces in the central and southern parts of the survey area. Small tracts of Blakeland and Truckton soils are included in the areas mapped.

Surface runoff is medium or slow. The hazard of erosion is slight.

This soil is not suitable for cultivation, and all of it is in native range. Overgrazing should be guarded against. (Capability unit VIs-3, climatic zone C; Gravelly Outwash range site; windbreak group 3)

Yoder-Truckton-Lismas complex (3 to 15 percent slopes) (Yt).—This complex occurs in the central and southern parts of the survey area. Small tracts of Blakeland and Bresser soils are included in the areas mapped.

Surface runoff is medium or rapid. The hazard of wind erosion and water erosion is severe if the grass cover is depleted.

This complex is not suitable for cultivation. A few fields were formerly cultivated, but most of them have been abandoned or reseeded to grass. Good range management is necessary to prevent overgrazing and to control erosion. (Capability unit VIs-3, climatic zone C; Yoder part is in Gravelly Outwash range site; Truckton part is in Sandy Grassland range site; Lismas part is in Shale Breaks range site and in windbreak group 5; Yoder and Truckton parts are in windbreak group 3)

Use and Management of the Soils

The soils of this survey area are used mainly for pasture and range and for growing feed for livestock. Wheat, sorghum, and small grains are the most commonly raised cash crops.

This section explains how the soils may be managed for these main purposes, and also for planting windbreaks, providing habitats for wildlife, and building highways, farm ponds, and other engineering structures. It also gives the predicted yields of the principal crops grown under two levels of management. The method of presenting information is that of describing general practices suitable for all of the soils, and then grouping soils that require similar management, describing the group, and suggesting suitable management practices for it.

Management of Cropland

In this survey area the amount of effective rainfall is the main factor in determining the use and management of the soils. The area has been divided into climatic zones, according to the pattern tentatively set up for eastern Colorado. Climatic zones are established on the basis of data on temperature, rainfall, rate of evaporation, and length of growing season. In eastern Colorado the areas that have the best growing conditions are placed in climatic zone A, those that have the second best in zone B, those that have the third best

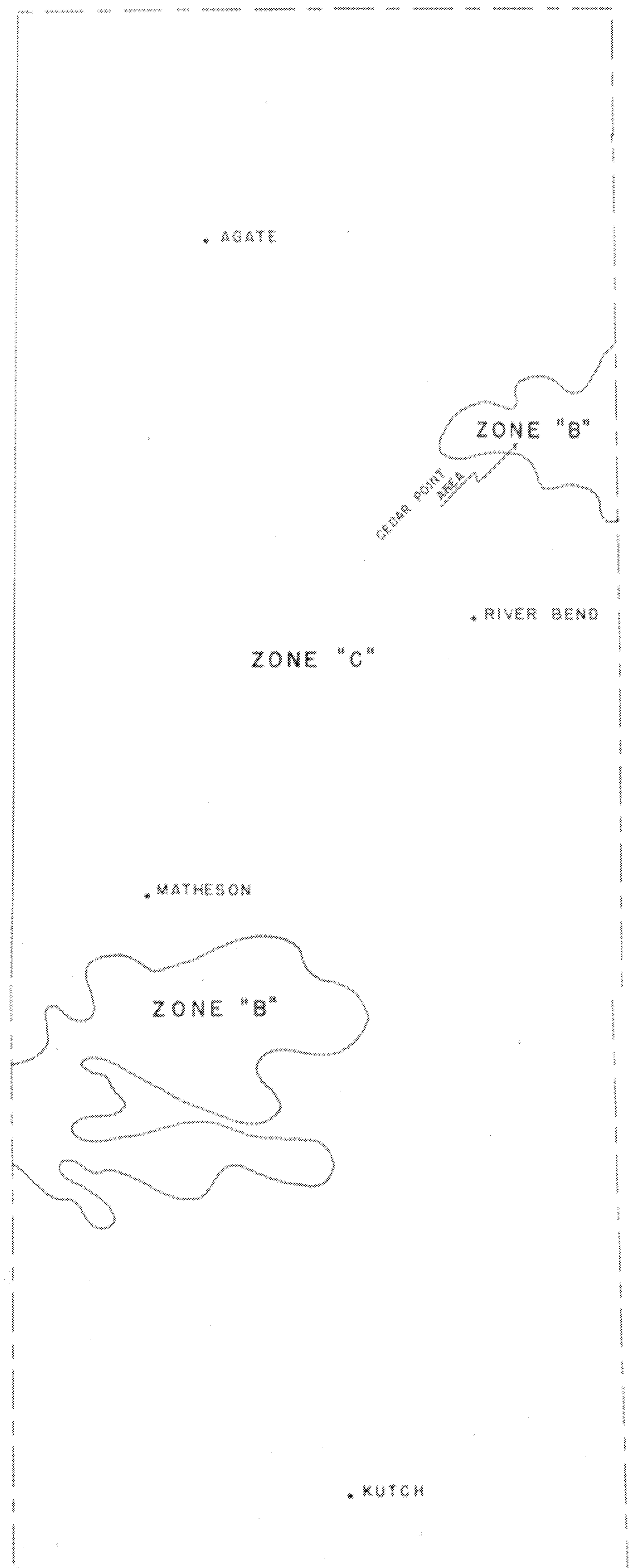

Figure 7.—Climatic zones in the eastern part of Elbert County There is more precipitation in zone B than in zone C.

in zone C, and those that have the least favorable growing conditions in climatic zone D.

Two of the climatic zones (fig. 7) established for eastern Colorado are represented in the eastern part of Elbert County. The larger part of the survey area, including most of the lower lying areas, is in zone C. Two small, higher lying areas, one a few miles south of Matheson and the other in the area of Cedar Point, are in zone B. Crop failure is more common in climatic zone C. Also, plant cover is more difficult to maintain, and the hazard of erosion is consequently more severe.

The climate of this survey area is characterized by extended dry periods, torrential storms, and persistent drying winds. Consequently, management that conserves moisture and controls erosion is essential to the successful use of the soils. Dryland farming practices are discussed in general terms in the following paragraphs and more specifically in the descriptions of the capability units.

Conservation of moisture

Summer fallow builds up the reserve of moisture in the subsoil. This stored moisture is then available to crops. Fallow cropland needs enough residue on the surface to protect it against wind and water erosion until the new crop is established. Weeds must be controlled so that they will not use up the stored moisture.

Moisture can be conserved in sloping areas by terracing and contour tillage. Terraces check runoff and hold water until the soils can absorb it. The additional moisture encourages plant growth, and the additional vegetation supplies organic matter and helps to control both wind and water erosion.

Erosion control.—About 65,000 acres in this survey area has been significantly damaged by erosion. Evidences of erosion include dunes in cultivated fields, accumulations of soil material in fence rows, undercutting of streambanks, and active gullies (fig. 8).

Both wind erosion and water erosion have damaged the soils (fig. 9), but the more extensive damage has been caused by wind erosion. Wind erosion, a constant hazard, is especially severe during droughts, when the sparse vegetative cover is further depleted. Silty and sandy soils are more highly susceptible to wind erosion than clayey soils. The soils most likely to be damaged by wind are those of the Wiley, Colby, Baca, Blakeland, Bresser, Truckton, Ascalon, Vebar, and Stoneham series.

Water erosion is a hazard to sloping soils of silty texture and to all steep soils. All of the bottom-land soils are subject to severe gullying caused by concentrated runoff from higher areas. Gullies are most likely to form in the Nunn, Christianburg, and Arvada soils, in some of the Kutch soils, and in Loamy alluvial land. Sheet erosion is also caused by running water. The soils most likely to be damaged by sheet erosion are those of the Baca, Weld, Platner, Ulm, and Renohill series.

Control of wind erosion.—Stubble-mulch tillage, emergency tillage, and maintenance of a continuous cover of growing plants or residues are practices that are effective in controlling wind erosion.

A cover can be kept on the soil throughout the year by growing crops or grass and leaving stubble or crop residue in the field after harvest. If there is enough

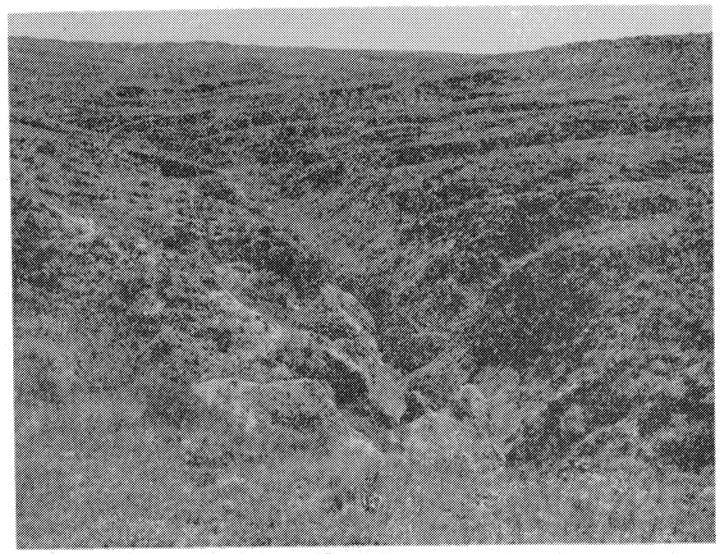

Figure 8.—**In this area of rangeland, erosion has caused deep gullies to form. Some of the gullies penetrate into the underlying sandstone and shale.**

moisture in the subsoil, wheat sown in fall will furnish enough cover to protect the soil during the blowing season. The stubble of wheat or of drilled sorghum helps to check wind erosion also.

Stubble-mulch tillage kills the weeds but disturbs the stubble only slightly. It leaves crop residues on the surface, increases the organic-matter content of the soil, improves structure, and prevents crusting and sealing of the surface.

Stubble mulching is effective wherever small grain or drilled sorghum is grown, either solid or in strips

Figure 9.—**Cultivated field eroded by both wind and water.**

alternating with strips of beans or corn. It is especially effective if strips of grain or sorghum are planted crosswise to the direction of the prevailing winds, and alternating with fallow strips of equal width.

Emergency tillage is costly in money, time, and soil fertility, but it is sometimes necessary in order to check wind erosion if a crop has failed or if stubble has been grazed too closely. This practice has little or no effect on deep sandy soils because, to be effective, the operation must bring up clods from the subsoil. If blowing is not severe, chisel marks or lister furrows 3 to 12 feet apart, crosswise to the direction of the prevailing wind, may be all that is needed. If blowing is severe, the marks or furrows need to be closer together, and in critical periods it may be necessary to chisel or list solidly over entire fields.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are subject to little or no erosion but have other limitations that restrict their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIIe-2 or VIe-10.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use. (None in this county.)

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices. (None in this county.)

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIc. Soils that have severe climatic limitations caused by inadequate rainfall and that are subject to moderate wind erosion if they are cultivated and not protected.
  - Unit IIIc-1.—Deep and moderately deep, well-drained soils that have a clayey subsoil.
- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Unit IIIe-1.—Deep and moderately deep, upland soils that have a clayey subsoil.
  - Unit IIIe-2.—Deep and moderately deep, well-drained, upland soils that have a subsoil of sandy clay loam.
  - Unit IIIe-3.—Deep and moderately deep, well-drained soils that have a loamy subsoil.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.
  - Unit IVe-1.—Deep and moderately deep, well-drained soils that have a loamy subsoil.
  - Unit IVe-2.—Deep and moderately deep, well-drained soils on stream terraces and on uplands.
  - Unit IVe-3.—Deep and moderately deep, well-drained, upland soils that have a moderately fine textured or medium-textured subsoil.
  - Unit IVe-4.—Deep and moderately deep, well-drained soils on alluvial terraces.
  - Unit IVe-5.—Deep and moderately deep, well-drained soils on uplands.
  - Unit IVe-6.—Deep and moderately deep, well-drained soils on uplands.

Class V. Soils that are not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

- Subclass Vw. Soils too wet for cultivation; drainage or protection not feasible.
  - Unit Vw-1.—Moderately sandy, stratified soils on nearly level and gently sloping stream terraces.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIe-1.—Deep, moderately sandy soils that have a moderately fine textured or medium-textured subsoil.

Unit VIe-2.—Coarse textured and moderately coarse textured soils on uplands.

Unit VIe-3.—Deep and moderately deep, medium-textured soils that have a moderately fine textured or medium-textured subsoil.

Unit VIe-4.—Shallow to deep, medium-textured soils that have a moderately fine textured subsoil.

Unit VIe-5.—Deep and moderately deep soils on sloping and moderately steep uplands.

Unit VIe-6.—Deep and moderately deep, clayey soils that have a moderately fine textured or fine textured subsoil.

Unit VIe-7.—Deep and moderately deep, medium-textured and fine-textured soils on uplands.

Unit VIe-8.—Deep, coarse-textured, excessively drained soils that have a moderately coarse textured subsoil.

Unit VIe-9.—Deep, coarse textured and moderately coarse textured soils.

Unit VIe-10.—Shallow to deep, sandy soils that have outcrops of fine-grained, calcareous sandstone.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by low moisture capacity, stones, or other features.

Unit VIs-1.—Deep and moderately deep, loamy and clayey soils on stream terraces and alluvial fans.

Unit VIs-2.—Shallow, gently sloping to moderately steep, clayey soils.

Unit VIs-3.—Deep and shallow, fine-textured to coarse-textured soils that are gently sloping to steep.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Unit VIw-1.—Moderately deep to shallow soils of bottom lands and low terraces.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIIe-1.—Deep and moderately deep, medium-textured and fine-textured soils on uplands.

Unit VIIe-2.—Deep and moderately deep, moderately fine textured soils on uplands.

Unit VIIe-3.—Deep and shallow, sloping or moderately steep soils on uplands.

Unit VIIe-4.—Deep and shallow, gently sloping to steep soils on uplands.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs-1.—Deep and moderately deep, saline and alkaline soils on stream terraces and alluvial fans.

Unit VIIs-2.—Shallow, calcareous, gravelly soils on gently sloping to moderately steep uplands.

Unit VIIs-3.—Broken land or barren sandstone and conglomerate and steep, exposed shale.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIe.—Soils or land types very severely limited, chiefly by rough and steep slopes, stoniness, or other soil and landscape features.

Unit VIIIe-1.—Rough, broken areas that have no agricultural value but support wildlife.

Unit VIIIe-2.—Bottom land that has no agricultural value but supports wildlife.

Unit VIIIe-3.—Rough, gullied areas that have no agricultural value but support wildlife.

Subclass VIIIs. Rock or soil materials that have little potential for production of vegetation.

Unit VIIIs-1.—Shifting, unvegetated sand and gravel that has no agricultural value and little or no value as a habitat for wildlife.

Management by capability units

All the soils in one capability unit need about the same kind of management and respond to management in about the same way. A soil, however, may be in more than one climatic zone and, thus, can be in more than one capability unit.

The capability units of this survey area are described in the following pages, and suitable management for the soils of each unit is discussed. All management suggestions are for dryland farming. Only small, scattered acreages are equipped for irrigation, and the sources of irrigation water are not dependable.

CAPABILITY UNIT IIIc-1

In this unit are deep and moderately deep, well-drained soils that have a clayey subsoil. The areas that have been placed in this unit occur on uplands in climatic zone B. Other areas of these same soils are in climatic zone C and because of less rainfall, greater risk of crop failure, and a more serious erosion hazard, have been placed in capability unit IVe-2. The soils are—

Stoneham loam, 1 to 3 percent slopes.
Weld loam, 0 to 1 percent slopes.
Weld loam, 1 to 3 percent slopes.

Although these soils are in parts of this survey area where the amount of effective precipitation is greatest, adverse climate is the factor that limits their use. Dry years are not uncommon, and sometimes several years in succession are dry. Consequently, raising cultivated crops is risky. The hazard of water erosion is slight, but there is always a moderate hazard of wind erosion unless a plant cover is maintained. Nevertheless, these are some of the best crop soils in the survey area.

The water-holding capacity is high, the available supply of plant nutrients is moderate, and the organic-matter content is moderate. Tillage is easy. Surface

Figure 10.—Forage sorghum, shocked after harvest. This is an area of Weld loam near Matheson.

runoff is slow or moderately slow, and most of the rainfall is absorbed. Yields vary, depending on rainfall. Ordinarily, the range is from fair to very good, but if rainfall is below normal, crops may fail.

Winter wheat is the crop best suited to these soils, but all of the locally grown dryland crops can be grown. Barley, forage sorghum (fig. 10), grain sorghum, and rye are commonly grown.

Cropping systems that conserve moisture and control erosion are needed. The system most commonly used consists of winter wheat, followed in alternate years by summer fallow, either fieldwide or in strips. If the wheat crop fails, sorghum can be planted early in summer as a catch crop. Barley and rye are good alternate grain crops.

Stubble-mulch tillage combined with summer fallow helps to control wind erosion, to conserve moisture, to maintain fertility and organic-matter content, and to control weeds. Grain stubble should be left 8 to 12 inches high. Windbreaks should be planted at right angles to the direction of the prevailing winds in areas where wind erosion has been active.

Slopes of more than 1 percent should be terraced in order to control water erosion and to conserve moisture. Broad-based terraces (fig. 11) are the most satisfactory type on these soils. The natural waterways should be planted to sod-forming grasses, in order to reduce water erosion and prevent gullying.

Native grasses are well suited to these soils; buffalograss, blue grama, and other short grasses are commonly grown. Introduced grasses, such as crested wheatgrass, intermediate wheatgrass, and Russian wildrye, can be grown for seed, hay, or pasture.

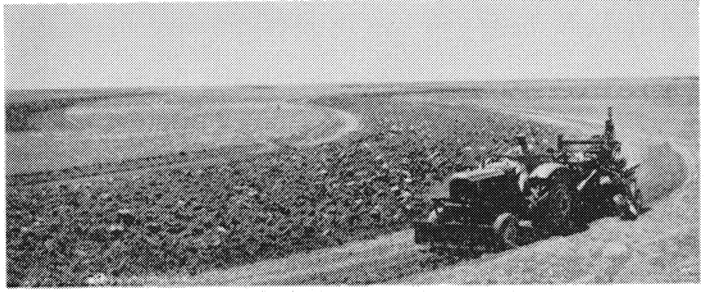

Figure 11.—Broad-based terraces like these hel) to protect the soils from erosion by water.

CAPABILITY UNIT IIIe-1

In this unit are deep and moderately deep soils that have a clayey subsoil. The areas that have been placed in this unit occur on uplands in climatic zone B. Other areas of these same soils are in climatic zone C and, because of less rainfall, greater risk of crop failure, and a more serious erosion hazard, have been placed in capability unit IVe-3. The soils are—

Baca loam, 3 to 5 percent slopes.
Stoneham loam, 3 to 5 percent slopes.
Weld loam, 3 to 5 percent slopes.

These soils are more susceptible to wind and water erosion than the soils in capability unit IIIc-1. Erosion is most active in areas where the soils are not protected by contour furrows, terraces, and diversions, and by a continuous cover of close-growing crops or crop residue. These soils have good capacity to store water, and most of the stored water is readily available to plants. The natural fertility is moderate. Tillage is easy. Water intake is medium or slow. Surface runoff is medium.

The best cropping system for these soils consists of wheat followed by fallow. If the wheat crop fails, sudangrass can be planted as temporary pasture. Drilled sorghum is a good alternate crop. Enough stubble and residue should be left to protect the soil through the next blowing season. For summer fallow, tillage should be delayed until weeds start to use moisture, which is usually after April 15.

Stubble-mulch tillage is essential if crops are grown on these soils. Leaving wheat stubble 8 to 10 inches high and sorghum stubble 10 to 12 inches high helps to protect the soils through fall and winter. Strip-fallowing at right angles to the direction of the prevailing winds helps to control blowing in areas that are not terraced and are not suitable for contour tillage.

Broad-based terraces, constructed on the contour, are useful in the conservation of soil and water. Normally, terraces should be closer together than those on the soils of capability unit IIIc-1. In the steeper and rougher areas, diversions help to break up concentrations of runoff and to spread the water more evenly, thus making better use of the rainfall and helping to control water erosion. Natural drainageways should be protected by sod-forming grasses.

Grasses are well suited to these soils. Western wheatgrass and blue grama are native grasses that are commonly grown. Crested wheatgrass, intermediate wheatgrass, and Russian wildrye are good introduced grasses.

CAPABILITY UNIT IIIe-2

In this unit are deep and moderately deep, well-drained soils that have a subsoil of sandy clay loam. The areas that have been placed in this unit occur on uplands in climatic zone B. Other areas of these same soils are in climatic zone C and, because of less rainfall, greater risk of crop failure, and a more serious erosion hazard, have been placed in capability unit IVe-5. The soils are—

Ascalon sandy loam, 1 to 3 percent slopes.
Bresser sandy loam, 1 to 3 percent slopes.

These soils are highly susceptible to wind erosion and need protection at all times. Tillage is easy, and the soils are readily permeable to moisture, air, and roots. The organic-matter content and the supply of plant nutrients are moderate.

Winter wheat, drilled sorghum, barley, and millet can be grown successfully. The safest cropping system consists of small grain followed by fallow. Drilled sorghum can be used as a catch crop or can be alternated with fallow.

Stubble-mulch tillage following the grain harvest is a good practice. Fallowing in strips or leaving a cover of weeds or stubble helps to keep the soils from blowing. The fallow strips should be at right angles to the direction of the prevailing winds. Broad-based terraces that are correctly spaced conserve moisture and help to control water erosion. Outlets for natural waterways should be protected by sod-forming grasses to control gullying and water erosion.

These soils are well suited to grass. The native grasses are mainly such mid grasses as sideoats grama, little bluestem, and needle-and-thread, and such short grasses as buffalograss and blue grama. Wheatgrass, sand lovegrass, Russian wildrye, and sweetclover are good introduced pasture plants.

CAPABILITY UNIT IIIe-3

In this unit are deep and moderately deep, well-drained soils that have a loamy subsoil. The areas that have been placed in this unit occur on uplands in climatic zone B. Other areas of these same soils are in climatic zone C and, because of less rainfall, greater risk of crop failure, and a more serious erosion hazard, have been placed in capability unit IVe-6. The soils are—

Ascalon sandy loam, 3 to 5 percent slopes.
Bresser sandy loam, 3 to 5 percent slopes.

These soils have a thinner surface layer and a thinner subsoil than the soils in capability unit IIIe-2. The soils of the two units are about equally productive. They have similar management problems, but those in unit IIIe-3 need more intensive conservation measures. Good management practices include the use of close-growing crops, the utilization of residue and stubble, terracing, and carefully timed stubble-mulch tillage. Fields that are not terraced and stubble mulched can be stripcropped.

Blue grama, sideoats grama, junegrass, little bluestem, and sandreed are native grasses suitable for range. Wheatgrass, sand lovegrass, Russian wildrye, and sweetclover are good pasture plants.

CAPABILITY UNIT IVe-1

In this unit are deep and moderately deep, well-drained soils that have a loamy subsoil. The areas that have been placed in this unit occur on sloping uplands in climatic zone B. Other areas of these same soils are in climatic zone C and, because of less rainfall, greater risk of crop failure, and a more serious erosion hazard, areas of the Ascalon soil occurring in that zone have been placed in capability unit VIe-1 and areas of the Bresser soil in that zone have been placed in capability unit VIe-9. The soils of capability unit IVe-1 are—

Ascalon sandy loam, 5 to 9 percent slopes.
Bresser sandy loam, 5 to 9 percent slopes.

These soils have a thinner surface layer and a thinner subsoil than the soils in capability unit IIIe-3. Generally, they are less suitable for regular cultivation and are less productive. They are more likely to erode because they have stronger, less uniform slopes and because they produce less vegetation. Surface runoff is medium or rapid.

Stubble mulching, minimum tillage, and the use of close-growing crops reduce the hazard of wind erosion. Channel-type terraces, supplemented by diversions, distribute runoff and help to control erosion. Wind strips at right angles to the direction of the prevailing winds help to protect fields that are not terraced. A good cover of grass checks both wind and water erosion.

These soils support good stands of grass. Blue grama and sideoats grama are suited. Crested wheatgrass, intermediate wheatgrass, Russian wildrye, and sand lovegrass are good introduced grasses.

CAPABILITY UNIT IVe-2

In this unit are deep and moderately deep, well-drained soils on stream terraces and uplands in climatic zone C. The soils of capability unit IVe-2 are—

Fort Collins loam, 0 to 3 percent slopes.
Nunn loam, 0 to 3 percent slopes.
Platner loam, 0 to 1 percent slopes.
Platner loam, 1 to 3 percent slopes.
Stoneham loam, 1 to 3 percent slopes.
Weld loam, 0 to 1 percent slopes.
Weld loam, 1 to 3 percent slopes.

Some areas of the Stoneham and Weld soils occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IIIc-1.

Unless the soils of capability unit IVe-2 are protected by close-growing crops or by grain stubble, they are highly susceptible to wind erosion and moderately susceptible to water erosion. Their capacity to hold water is high, and most of the stored water is available to plants. The supply of plant nutrients is moderate and the organic-matter content is moderate. Tillage is easy. Surface runoff is slow to medium. Yields are fair to good in years when moisture is favorable. Dry periods frequently cause crop failure, and the consequent lack of plant cover increases the hazard of wind erosion.

In years when the moisture supply is adequate, a good cropping system for these soils is winter wheat followed by summer fallow. If the wheat crop fails, sudangrass or sorghum can be planted in spring as a catch crop and to provide plant cover.

Stubble-mulch tillage is essential if crops are grown on these soils. Undisturbed stubble protects the soil during the windy season, and in very dry years stubble and weeds can be left standing for protection against blowing. Minimum tillage and delayed initial tillage make stubble mulching more effective.

Stripcropping on the contour or across the direction of the prevailing winds helps to control wind erosion and to conserve moisture. Emergency tillage with a chisel is effective for temporary protection.

Broad-based terraces, combined with contour farming and stubble mulching, help to stabilize yields because they conserve moisture and help to control erosion. Protected and seeded waterways may be needed as outlets for the terraces and for the natural drainageways.

Permanent grasses provide good pasture and help to control erosion. Blue grama and western wheatgrass are suitable for range seeding. Crested wheatgrass and Russian wildrye are good introduced pasture grasses.

CAPABILITY UNIT IVe-3

In this unit are deep and moderately deep, well-drained soils on uplands in climatic zone C. They have a moderately fine textured or medium-textured subsoil. The soils of capability unit IVe-3 are—

Baca loam, 3 to 5 percent slopes.
Platner loam, 3 to 5 percent slopes.
Stoneham loam, 3 to 5 percent slopes.
Ulm loam, 1 to 5 percent slopes.
Weld loam, 3 to 5 percent slopes.

Some areas of the Baca, Stoneham, and Weld soils occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IIIe-1.

The soils of capability unit IVe-3 have a thinner surface layer and a thinner subsoil than the soils of capability unit IVe-2. The soils of the two units have similar management problems, but those in unit IVe-3 need more intensive conservation measures.

Terraces supplemented by diversions help to control and spread runoff. Delayed and reduced tillage preserves residue needed for stubble mulching and control of erosion.

Blue grama and western wheatgrass are suitable native grasses. Crested wheatgrass and sweetclover are suitable introduced pasture plants.

CAPABILITY UNIT IVe-4

In this unit are deep and moderately deep, well-drained soils on alluvial terraces in climatic zone C. The subsoil is fine textured or moderately fine textured. The soils are—

Christianburg sandy loam, 0 to 3 percent slopes.
Nunn sandy loam, 0 to 3 percent slopes.

If these soils are cultivated, wind erosion is a hazard. Water erosion is a moderate hazard. The surface layer takes in water readily, and the subsoil has a high capacity to store water. Surface runoff is slow or medium. Fertility is moderate. Tillage is easy or moderately easy. Yields of cultivated crops are fair in years when moisture conditions are favorable. The main crops are wheat, sorghum, and barley.

A cropping system based on close-growing drilled crops conserves moisture and helps to control both water and wind erosion. Stubble-mulch tillage, stripcropping, and the use of grassed waterways also conserve moisture and help to control erosion. Emergency tillage by chiseling or listing crosswise to the prevailing winds is effective for temporary protection.

A permanent stand of grass helps to control erosion and also provides grazing for livestock. These soils are well suited to permanent grasses, such as blue grama, sideoats grama, crested wheatgrass, Russian wildrye, and sand lovegrass.

CAPABILITY UNIT IVe-5

In this unit are deep and moderately deep, well-drained soils on uplands in climatic zone C. The subsoil is finer textured than the surface layer. The soils are—

Ascalon sandy loam, 1 to 3 percent slopes.
Bresser sandy loam, 1 to 3 percent slopes.
Platner-Ascalon sandy loams, 0 to 3 percent slopes.
Truckton sandy loam, 1 to 3 percent slopes.

Some areas of the Ascalon and Bresser soils occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IIIe-2.

The soils of capability unit IVe-5 are highly susceptible to both wind and water erosion. They are readily permeable to moisture, air, and roots. Tillage is easy. Surface runoff is slow or medium. The organic-matter content is sometimes low. The supply of plant nutrients is moderate. Yields vary, depending on rainfall. In favorable years yields of small grain and sorghum are good, but if rainfall is below normal, crops may fail.

A cropping system based on close-growing drilled crops conserves moisture and controls wind erosion. Broad-based terraces help to conserve rainfall. Stubble-mulch tillage and stripcropping are more effective if, after harvest, wheat stubble is left 8 to 10 inches high and sorghum stubble is left 10 to 12 inches high. Stripcropping at right angles to the direction of the prevailing winds or on the contour will help to conserve moisture and control erosion. Natural or seeded waterways should be protected from grazing to prevent gullying and control water erosion. Emergency tillage with a chisel or a lister is effective for temporary protection during blowing seasons.

These soils are suited to temporary pasture or to annual crops for supplemental feed. Sudangrass is suitable if it is planted in June and if enough growth is left to protect the soil through winter and spring. Suitable permanent grasses for range or pasture include blue grama, sideoats grama, crested wheatgrass, Russian wildrye, and sand lovegrass.

CAPABILITY UNIT IVe-6

In this unit are deep and moderately deep, well-drained soils on uplands in climatic zone C. They have a loamy subsoil. The soils of capability unit IVe-6 are—

Ascalon sandy loam, 3 to 5 percent slopes.
Bresser sandy loam, 3 to 5 percent slopes.
Platner-Ascalon sandy loams, 3 to 5 percent slopes.
Stoneham sandy loam, 1 to 5 percent slopes.

Some areas of the Ascalon and Bresser soils occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IIIe-3. The soils of capability unit IVe-6 have a thinner surface layer and a thinner subsoil than the soils of capability unit IVe-5. They contain more coarse sand and are more susceptible to erosion. The soils of the two units have similar management problems, but those of unit IVe-6 need more intensive conservation measures.

Close-growing crops require little tillage and provide the residue needed for control of erosion. Terraces supplemented by diversions check runoff and help to control water erosion. Stubble and crop residue left on the surface help to control erosion and to maintain the organic-matter content.

Natural drainageways and outlets for terraces can be protected by planting them to sod-forming grasses. Tillage of fields that are to be left fallow should be delayed until weeds have begun to use the stored moisture. Deep chiseling and listing are effective for temporary protection if the soil starts to blow.

A permanent stand of grass, properly managed, controls erosion and also provides grazing for livestock. Blue grama, sideoats grama, crested wheatgrass, Russian wildrye, and sand lovegrass are suitable.

CAPABILITY UNIT Vw-1

Wet alluvial land makes up this capability unit. It consists of stratified layers of moderately sandy soil material on nearly level and gently sloping stream terraces in climatic zone C. The water table is high throughout the growing season, and cultivation is not practical. The high water table makes this land type valuable as range. A few areas would be improved by artificial drainage.

Most of the acreage is used for grazing, but some of it is mowed for hay. A large part of the acreage could be improved by introducing wheatgrass, bromegrass, switchgrass, and such legumes as sweetclover and alfalfa.

CAPABILITY UNIT VIe-1

In this unit are deep, moderately sandy soils of climatic zone C. They have a moderately fine textured or medium-textured subsoil. The soils of capability unit VIe-1 are—

Ascalon sandy loam, 5 to 9 percent slopes.
Ascalon sandy loam, 9 to 15 percent slopes.
Stoneham sandy loam, 5 to 18 percent slopes.
Terry fine sandy loam, 5 to 20 percent slopes.

Some areas of Ascalon sandy loam, 5 to 9 percent slopes, occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IVe-1. The soils of capability unit VIe-1 occur in the drier part of the survey area. They are too steep, too erodible, or too droughty to be suitable for cultivation. Wind erosion is a hazard unless a good cover of vegetation is maintained. Establishing a good stand of grass is difficult. In areas that were formerly cultivated, a stubble crop should be grown to stabilize the soils before they are reseeded to grass. The grass cover can be improved by spraying the brush and by deferring grazing through spring and summer.

These soils are best suited to range or pasture. Native grasses are little bluestem, sand bluestem, sandreed, big bluestem, needle-and-thread, buffalograss, and blue grama.

CAPABILITY UNIT VIe-2

In this capability unit are coarse textured and moderately coarse textured soils on uplands in climatic zone C. They have a moderately fine textured subsoil. The soils are—

Ascalon complex, 1 to 3 percent slopes, eroded.
Ascalon complex, 3 to 5 percent slopes, eroded.
Bresser complex, 3 to 5 percent slopes, eroded.
Stoneham complex, 1 to 5 percent slopes, eroded.

These soils have been eroded by wind to such an extent that little or none of the original surface layer remains. In old fields there are spots where erosion has removed the surface layer and the subsoil as well.

To stabilize and reclaim these soils, it is necessary first to smooth the surface and then to reestablish the vegetation. Small grain or sorghum should be drilled the first season, and 8 to 14 inches of stubble should be left when the crop is harvested. Areas where the hazard of further wind erosion is severe should be stripcropped, and the weedy cover should be left on the alternate strips. The following season, grasses suited to sandy soils should be seeded in the stubble. No grazing should be allowed until the grass is well enough established to produce seed, and grazing should be carefully controlled for 3 to 5 years so that adequate root systems can develop, surface litter can accumulate, and the organic-matter content of the soils can be built up. These practices will help to control runoff and conserve moisture and will improve tilth and increase water-holding capacity.

Grasses suitable for these soils include sandreed, sand lovegrass, sand bluestem, and little bluestem.

CAPABILITY UNIT VIe-3

In this unit are deep and moderately deep, medium-textured soils of climatic zone C. They have a moderately fine textured or medium-textured subsoil. The soils are—

Nunn loam, 3 to 5 percent slopes, severely eroded.
Platner loam, 5 to 9 percent slopes.
Wiley and Colby soils, 3 to 5 percent slopes.

Some areas of these soils are cultivated, but generally the soils are better suited to pasture or to range than to crops, because they are sloping and unstable. If cultivated, they are moderately to severely erodible. Surface runoff is medium or rapid. The water-holding capacity is high.

Areas now cultivated ought to be reseeded to grass. A stubble crop is needed to stabilize the soils before they are reseeded to grass. Grazing animals should be excluded until grass is established.

Blue grama and buffalograss are dominant in the areas used for native range.

CAPABILITY UNIT VIe-4

In this unit are shallow to deep, medium-textured soils of climatic zone C. They have a moderately fine textured subsoil. The soils are—

Baca loam, 5 to 15 percent slopes.
Midway-Bainville complex.
Midway-Ulm complex.
Ulm loam, 5 to 12 percent slopes.
Wiley and Colby soils, 5 to 18 percent slopes.

These soils cannot be cultivated safely or profitably because of the slope and the severe hazard of sheet and gully erosion if the plant cover is depleted. In some areas they are too shallow for cultivation. Surface runoff is medium or rapid. The water-holding capacity is moderate to high. Pitting, furrowing, the use of stockwater ponds to store water, and the use of diversions to carry runoff help to conserve moisture and control erosion.

These soils are best suited to pasture or range, and areas now cultivated ought to be reseeded to grass. A stubble crop is needed to stabilize the soils before they are reseeded to grass. Grazing animals should be excluded until grass is established.

The native vegetation consists mainly of sideoats grama, little bluestem, western wheatgrass, and blue grama.

CAPABILITY UNIT VIe-5

In this unit are deep and shallow soils on sloping and moderately steep uplands in climatic zone C. The sur-

face layer is medium textured, and the subsoil is moderately fine textured. The soils are—

Baca complex, 5 to 15 percent slopes, eroded.
Midway-Bainville complex, eroded.

Most of the areas were formerly cultivated or have been overgrazed. The native vegetation has been depleted, and severe sheet and gully erosion has resulted. In places the subsoil and the underlying material are exposed. Rills and gullies are numerous. Contour furrowing, pitting, and diverting runoff help to control erosion and to conserve water.

Seeding is necessary to restore the vegetative cover. A stubble crop is needed to stabilize the soils before they are reseeded to grass. Grazing should be deferred until grass is established.

Suitable native grasses are little bluestem, sideoats grama, western wheatgrass, and blue grama.

CAPABILITY UNIT VIe-6

In this unit are deep and moderately deep, clayey soils of climatic zone C. They have a moderately fine textured or fine textured subsoil. The soils are—

Christianburg clay, 3 to 5 percent slopes.
Kutch clay, 1 to 5 percent slopes.
Kutch clay, 5 to 15 percent slopes.
Renohill clay loam.

These soils are not suitable for cultivation. They need a good cover of grass for protection against erosion. Contour furrowing or pitting help to conserve moisture and to control erosion. Runoff is rapid, permeability is slow, and the rate of infiltration is slow.

If these soils are properly managed, they produce good stands of grass. Suitable native grasses are blue grama, western wheatgrass, buffalograss, and galleta. Browse plants, such as fourwing saltbush, rabbitbrush, and winterfat, are intermingled with the native grasses.

CAPABILITY UNIT VIe-7

In this unit are deep and moderately deep, medium-textured and fine-textured soils on uplands in climatic zone C. The soils are—

Slickspot-Kutch complex, 3 to 9 percent slopes.
Ulm-Beckton complex, 3 to 9 percent slopes.

Water erosion is a serious hazard on these soils because the rate of infiltration is slow and surface runoff is rapid. Furrowing, pitting, or diverting runoff helps to control erosion.

In most places the grass cover is good, but it is sparse or lacking in some areas. The main grasses are western wheatgrass, alkali sacaton, and blue grama.

CAPABILITY UNIT VIe-8

In this unit are deep, coarse-textured, excessively drained soils of climatic zone C. They have a moderately coarse textured subsoil. The soils are—

Blakeland loamy sand.
Vebar loamy fine sand, 3 to 5 percent slopes.
Vebar loamy fine sand, 5 to 20 percent slopes.

These soils are not suited to cultivated crops, but they are well suited to grass. The hazard of wind erosion is severe if the plant cover is removed, and good management is essential if the grass cover is to be maintained. The rate of infiltration is rapid. Water-holding capacity is low, but all of the stored water is readily available to plants.

CAPABILITY UNIT VIe-9

In this unit are deep, coarse textured and moderately coarse textured soils of climatic zone C. They have a moderately fine textured to coarse-textured subsoil. The soils of capability unit VIe-9 are—

Bresser sandy loam, 5 to 9 percent slopes.
Bresser sandy loam, 9 to 15 percent slopes.
Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes.
Eastonville loamy sand, 0 to 3 percent slopes.
Eastonville loamy sand, 3 to 5 percent slopes.
Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded.
Truckton sandy loam, 3 to 5 percent slopes.
Truckton sandy loam, 5 to 20 percent slopes.

Some areas of Bresser sandy loam, 5 to 9 percent slopes, occur in climatic zone B, where growing conditions are better, and have been placed in capability unit IVe-1.

The soils of capability unit VIe-9 are not suitable for cultivation, because of slope, unstable structure, or droughtiness. The erosion hazard is severe. Areas presently or formerly cultivated ought to be reseeded to grass. A stubble crop is needed to stabilize the soils before they are reseeded.

CAPABILITY UNIT VIe-10

The only mapping unit assigned to this capability unit is Terry-Vebar-Tullock complex, 5 to 25 percent slopes. The soils in this unit occur in climatic zone C. They are sandy and shallow to deep. There are some outcrops of fine-grained, calcareous sandstone.

The soils are mostly too steep and too droughty to be suitable for cultivation. They are susceptible to wind erosion and water erosion if the plant cover is depleted. Overgrazing should be prevented. Furrowing, pitting, and diversions as a means of controlling erosion are not generally feasible, because the soils are unstable. The rate of infiltration is rapid, and the water-holding capacity is moderate to low.

Native grasses include sandreed, big bluestem, sand bluestem, indiangrass, switchgrass, little bluestem, and sideoats grama.

CAPABILITY UNIT VIs-1

In this unit are deep and moderately deep, saline or alkali soils on stream terraces and alluvial fans in climatic zone C. The soils are—

Arvada loam, 0 to 3 percent slopes.
Christianburg clay, 0 to 3 percent slopes.

These soils are either too clayey or too saline to be used for cultivated crops. The rainfall is too scant to offset the effects of salts or of fine texture. Most of the acreage is on bottom lands and receives runoff from adjacent slopes. In some places the additional water is beneficial, and in these places the soils are productive if the salt content is not high.

CAPABILITY UNIT VIs-2

One soil, Lismas clay, makes up this capability unit. This soil occurs in climatic zone C. It is shallow and gently sloping to moderately steep.

This soil is not suited to cultivation. Permeability is slow, and the rate of infiltration is slow. Control of

grazing is particularly important because it is difficult to reestablish the plant cover once it is depleted.

If reseeding becomes necessary, it is advisable to prepare the site by range pitting or contour furrowing and to plant the seed in a protective stubble. Western wheatgrass and blue grama are the most suitable grasses for reseeding.

CAPABILITY UNIT VIs-3

In this unit are deep and shallow, fine-textured to coarse-textured soils of climatic zone C. They are gently sloping to steep. The soils are—

Terry-Lismas complex.
Yoder gravelly sandy loam.
Yoder-Truckton-Lismas complex.

These soils are not suited to cultivation. They are highly susceptible to erosion. Good management is important because it is difficult to reestablish the plant cover if it is overgrazed.

These soils are used mainly for native grass. The coarse-textured soils are suited to mid grasses. The fine-textured soils are suited to western wheatgrass and blue grama.

CAPABILITY UNIT VIw-1

In this unit are two land types that consist of moderately deep to shallow alluvium on nearly level or very gently sloping bottom lands (fig. 12) and low terraces in climatic zone C. The surface layer is medium textured or coarse textured. The subsoil is rapidly permeable to slowly permeable. The two land types are—

Loamy alluvial land.
Sandy alluvial land.

These deposits are too shallow or too coarse textured to be suitable for cultivation. The hazard of erosion is severe if the plant cover is removed.

Suitable native grasses include western wheatgrass, switchgrass, sideoats grama, blue grama, sandreed, sand bluestem, and little bluestem.

CAPABILITY UNIT VIIe-1

In this unit are deep and moderately deep, medium-textured and fine-textured soils on uplands in climatic zone C. The soils are—

***Figure 12.*—Sandy alluvial land along Horse Creek. This land type is not suitable for cultivation, because it periodically receives damaging deposits of sand or silt from stream overflow or from runoff after rainstorms.**

Ulm loam, 5 to 12 percent slopes, severely eroded.
Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded.

These soils are not suited to cultivation. Some of the areas were formerly cultivated but have been abandoned. Surface runoff is rapid, and the hazard of water erosion is severe.

If the vegetation on these soils deteriorates, it must be allowed to recover by natural reseeding, because the use of equipment for preparation of a seedbed and for reseeding is not practical. Deferment of grazing and proper range use hasten natural recovery.

CAPABILITY UNIT VIIe-2

In this unit are deep and moderately deep, moderately fine textured soils on uplands in climatic zone C. They have a moderately fine textured or fine textured subsoil. The soils are—

Kutch clay, 5 to 15 percent slopes, severely eroded.
Renohill complex, 3 to 15 percent slopes, eroded.
Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded.

Sheet and gully erosion, following overgrazing of pastures and cultivation of some areas, have left these soils in critical condition. The use of machinery for reseeding is impractical, and the only way of restoring the range vegetation is to defer grazing long enough that the vegetation can reseed and reestablish itself naturally.

CAPABILITY UNIT VIIe-3

In this unit is one complex of deep and shallow, sloping or moderately steep soils on uplands in climatic zone C. This complex is—

Terry-Lismas complex, severely eroded.

Most of the plant cover has been removed from this soil, and consequently, the hazards of wind erosion and water erosion are severe. Sheet erosion and gully erosion are active in most areas. Where the surface layer is sandy, there are hummocks formed by wind.

If erosion is active and the plant cover is sparse, grazing should be deferred until the grass is reestablished. Some areas can be fenced to keep livestock out and to permit recovery through natural reseeding and root spread.

CAPABILITY UNIT VIIe-4

In this unit are deep and shallow, gently sloping to steep soils on uplands in climatic zone C. The texture of the surface layer ranges from fine to medium, and the texture of the subsoil is fine or moderately fine. Runoff is rapid. The soils are—

Lismas clay, eroded.
Midway-Ulm complex, severely eroded.

These soils have been seriously damaged by sheet and gully erosion, and the vegetation has been destroyed. The use of equipment for reseeding is impractical, and the only way to reestablish the vegetation is to defer grazing long enough to allow natural recovery. After new plants are established, grazing should be controlled so that the stand can maintain itself.

CAPABILITY UNIT VIIs-1

In this unit are deep and moderately deep, saline and alkaline soils on stream terraces and alluvial fans in

climatic zone C. These soils are fine textured and moderately fine textured. They are—

Arvada complex, 0 to 3 percent slopes, eroded.
Christianburg clay, 0 to 3 percent slopes, severely eroded.

These soils have been severely damaged by water erosion because the plant cover is not adequate to check runoff. Some areas are deeply gullied. Dams and spreader ditches are needed for control of runoff. The actively eroding banks of large gullies should be sloped.

The vegetative cover can be restored by preparing a seedbed and planting western wheatgrass, alkali sacaton, vine-mesquite, and blue grama. Grazing should be deferred until the new plants are established.

CAPABILITY UNIT VIIs-2

Gravelly land makes up this capability unit. It consists of shallow, calcareous, gravelly soil material on gently sloping to moderately steep uplands in climatic zone C.

This land is not suited to cultivation; it is best suited to native range. In most of the areas machinery cannot be used for reseeding, because the slopes are too strong or too rough. Surface runoff is medium or rapid, water intake is good, and the water-holding capacity is low.

Control of grazing is necessary to prevent deterioration of the vegetative cover and to help control erosion.

CAPABILITY UNIT VIIs-3

Rough broken land makes up this capability unit. It consists of broken land, barren outcrops of sandstone and conglomerate, and steep exposures of shale in climatic zone C.

This land is not suited to cultivation, because it is rough, shallow, or steep. Some of the areas have a good cover of grass and shrubs that are used for forage. Scrubby pinyon pine and juniper trees grow in much of the area and provide protection for grazing animals and wildlife.

CAPABILITY UNIT VIIIe-1

Badlands, which consists of extremely rough areas in climatic zone C, makes up this capability unit. The rough topography resulted from the action of wind and water on interbedded shale, siltstone, and fine-grained sandstone. This land type has no agricultural value, but it furnishes food and cover for cottontails, jackrabbits, badgers, skunks, coyotes, deer, antelope, and many kinds of birds.

CAPABILITY UNIT VIIIe-2

Breaks-Alluvial land complex, which consists of loamy and sandy bottom lands dissected by streams and gullies, makes up this capability unit. This land type has no agricultural value, but the rough, inaccessible parts provide a habitat for wildlife. There are a few scattered trees, and some of the steep, protected areas support shrubs that furnish food and cover for antelope, for rabbits and other small animals, and for birds.

CAPABILITY UNIT VIIIe-3

Rough gullied land, which consists almost entirely of gullies 3 to 80 feet deep, makes up this capability unit. This land type is in climatic zone C. It has no agricultural value, but the rough, inaccessible parts provide a habitat for wildlife. There are a few scattered trees, and some of the protected areas along the bottoms of the gullies support shrubs and grass that furnish food and cover for antelope, for rabbits and other small animals, and for birds.

CAPABILITY UNIT VIIIs-1

Riverwash, which consists of sandy and gravelly alluvium, makes up this capability unit. This land type occupies stream channels and bottom lands throughout the survey area. It is often flooded, and the soil material is shifted so frequently that little or no vegetation grows. The areas have no agricultural value and little or no value as a habitat for wildlife.

Predicted Yields of Principal Crops

The predicted average yield per acre of the principal crops grown in the survey area under two levels of management are given in tables 2 and 3. These predictions are based on observations over a long period of time and on information obtained from farmers and agricultural leaders.

Yields of wheat, barley, sorghum, and pinto beans depend mainly on the amount of moisture stored in the soil and the amount of rainfall during the growing season. In this survey area, differences among the soils are less important than variations in the amount of rainfall. The average amount of rainfall is greater in climatic zone B than in climatic zone C, and consequently, higher average yields can be expected in climatic zone B.

TABLE 2.—*Predicted average acre yields of principal crops grown in climatic zone B*

[Yields in columns A can be expected under common management. Yields in columns B can be expected under improved management. Soils not listed in this table are not suited to cultivated crops in climatic zone B, and no yield predictions are made]

Soil	Winter wheat		Barley		Forage sorghum	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
Ascalon sandy loam, 1 to 3 percent slopes	19	22	17	20	2,500	4,000
Ascalon sandy loam, 3 to 5 percent slopes	19	22	17	20	2,500	4,000
Ascalon sandy loam, 5 to 9 percent slopes	14	20	13	16	1,000	2,500
Baca loam, 3 to 5 percent slopes	14	18	13	17	2,000	3,000
Bresser sandy loam, 1 to 3 percent slopes	19	22	17	20	2,500	4,000
Bresser sandy loam, 3 to 5 percent slopes	19	22	17	20	2,500	4,000
Bresser sandy loam, 5 to 9 percent slopes	14	20	13	16	1,000	2,500
Stoneham loam, 1 to 3 percent slopes	17	20	15	18	2,000	3,000
Stoneham loam, 3 to 5 percent slopes	16	20	14	17	2,000	3,000
Weld loam, 0 to 1 percent slopes	19	22	17	20	2,000	3,000
Weld loam, 1 to 3 percent slopes	19	22	17	20	2,000	3,000
Weld loam, 3 to 5 percent slopes	19	22	17	20	2,000	3,000

TABLE 3.—*Predicted average acre yields of principal crops grown in climatic zone C*

[Yields in columns A can be expected under common management. Yields in columns B can be expected under improved management. Soils not listed in this table are not suited to cultivated crops in climatic zone C]

Soil	Winter wheat		Barley		Forage sorghum	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
Ascalon sandy loam, 1 to 3 percent slopes	14	18	12	16	2,000	3,500
Ascalon sandy loam, 3 to 5 percent slopes	14	18	12	16	2,000	3,500
Baca loam, 3 to 5 percent slopes	12	16	10	14	1,500	2,500
Bresser sandy loam, 1 to 3 percent slopes	14	18	12	16	2,000	3,500
Bresser sandy loam, 3 to 5 percent slopes	14	18	12	16	2,000	3,500
Christianburg sandy loam, 0 to 3 percent slopes	6	10	8	12	1,500	3,000
Fort Collins loam, 0 to 3 percent slopes	13	17	11	15	1,500	2,500
Nunn loam, 0 to 3 percent slopes	12	16	11	15	1,500	2,000
Nunn sandy loam, 0 to 3 percent slopes	13	17	12	16	2,000	2,500
Platner loam, 0 to 1 percent slopes	13	17	11	15	1,500	2,500
Platner loam, 1 to 3 percent slopes	13	17	11	15	1,500	2,500
Platner loam, 3 to 5 percent slopes	12	16	10	14	1,500	2,500
Platner-Ascalon sandy loams, 0 to 3 percent slopes	14	18	12	16	2,000	3,500
Platner-Ascalon sandy loams, 3 to 5 percent slopes	14	18	12	16	2,000	3,500
Stoneham loam, 1 to 3 percent slopes	13	17	11	14	2,000	2,500
Stoneham loam, 3 to 5 percent slopes	12	17	10	14	2,000	2,500
Stoneham sandy loam, 1 to 5 percent slopes	12	16	10	14	1,500	3,000
Truckton sandy loam, 1 to 3 percent slopes	13	17	11	15	2,000	3,500
Ulm loam, 1 to 5 percent slopes	12	16	11	14	1,500	2,500
Weld loam, 0 to 1 percent slopes	13	17	11	15	1,500	2,500
Weld loam, 1 to 3 percent slopes	13	17	11	15	1,500	2,500
Weld loam, 3 to 5 percent slopes	12	16	10	14	1,500	2,500

Yields in columns A are obtained under common management, which does not include regular cropping systems or conservation measures. Yields in columns B are those that can be expected under improved management, including planned cropping systems and measures that conserve soil and moisture.

Rangeland [2]

More than half of the survey area is used for range. The raising of beef cattle (fig. 13) is the main enterprise, and management of rangeland is the most important soil and water conservation program in this part of the county. Originally, the grasslands had good capacity to absorb water, and they supported a vigorous growth of range plants that could maintain cattle the year around, with little supplemental feed. The success of the livestock enterprise now depends on restoring the range, as nearly as practicable, to its original condition and on maintaining the production of herbage.

The semiarid climate complicates the problem of grass management. Periods of drought often have serious consequences. An abundance of rainfall, however, does not eliminate the need for good management of the native range. Available moisture is not fully utilized unless the grasses are healthy and the soil is in good condition. If the soil is packed down by continuous trampling, it loses much of its air space and, consequently, much of its capacity to absorb moisture. Not uncommonly, less moisture is absorbed by the soils in heavily grazed pastures than in cultivated fields.

Range sites and condition classes

A range site is an area of natural grazing land that, because of its particular combination of soil, climate, and topography, is capable of supporting a particular type and amount of native vegetation.

Range condition refers to the present composition of the native vegetation on a given site in relation to that of the native vegetation that could grow on that site. Four classes of range condition are defined. The site is in excellent condition if 75 to 100 percent of the stand consists of the best kinds of native vegetation the site is capable of producing. It is in good condition if the percentage is between 50 and 75 percent; in fair condition if the percentage is between 25 and 50 percent; and in poor condition if the percentage is less than 25. The percentages apply to the kinds of vegetation, not to the density of the grass.

To be able to plan an effective program of range management, it is necessary to identify the range sites, to learn their potential production in terms of kind and quantity, and to be able to recognize changes in the vegetation that indicate improvement or deterioration of the range.

In this survey area 13 range sites are recognized. These are discussed in the following pages. (The following land types are unsuitable for use as range and are not included in any range site: Badlands, Breaks-Alluvial land complex, Riverwash, and Rough gullied land.)

DEEP SAND RANGE SITE

This range site is in the northeastern part of the survey area. The soils in this site are—

Blakeland loamy sand.
Terry-Vebar-Tullock complex, 5 to 25 percent slopes (Vebar soil only).
Vebar loamy fine sand, 3 to 5 percent slopes.
Vebar loamy fine sand, 5 to 20 percent slopes.

The main tall grasses on this site are sandreed (*Calamovilfa longifolia*) and sand bluestem (*Andropogon hallii*). Switchgrass (*Panicum virgatum*) grows in the low places and in draws. The mid grasses, such as needle-and-thread (*Stipa comata*), little bluestem (*Andropogon scoparius*), and sideoats grama (*Bouteloua curtipendula*), are plentiful and predominate in some

[2] By CARLTON S. FONTE, range conservationist, Soil Conservation Service.

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Figure 13.—Cattle grazing near stock pond. The soil is Ascalon sandy loam, 3 to 5 percent slopes. This is in the southern part of the survey area.

areas. Blue grama (*Bouteloua gracilis*), a short grass, forms an understory, but yields only a small amount of herbage. Leadplant (*Amorpha canescens*), prairie-clover (*Petalostemon*), and other legumes grow on this site. Sand sage (*Artemisia filifolia*) makes up a minor part of the plant cover.

If this site is in excellent condition, the yield of air-dry herbage varies between 2,000 pounds per acre in favorable years and 1,200 pounds in unfavorable years. If the site is in poor condition, the yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

SANDY PLAINS RANGE SITE

This range site (fig. 14) occurs mainly in the eastern part of the survey area, in climatic zone C. The intake of moisture is good on the soils of this site, but runoff may occur during severe storms if the plant cover has been depleted. If the condition of the range is fair or poor, wind erosion and water erosion are hazards. The soils in this site are—

- Ascalon sandy loam, 1 to 3 percent slopes.
- Ascalon sandy loam, 3 to 5 percent slopes.
- Ascalon sandy loam, 5 to 9 percent slopes.
- Ascalon sandy loam, 9 to 15 percent slopes.
- Ascalon complex, 1 to 3 percent slopes, eroded.
- Ascalon complex, 3 to 5 percent slopes, eroded.
- Platner-Ascalon sandy loams, 0 to 3 percent slopes.
- Platner-Ascalon sandy loams, 3 to 5 percent slopes.
- Stoneham sandy loam, 1 to 5 percent slopes.
- Stoneham sandy loam, 5 to 18 percent slopes.
- Stoneham complex, 1 to 5 percent slopes, eroded.
- Terry fine sandy loam, 5 to 20 percent slopes.
- Terry-Vebar-Tullock complex, 5 to 25 percent slopes (Terry soil only).

The most abundant grasses on this site are sideoats grama, little bluestem, and needle-and-thread, which are mid grasses. Tall grasses on this site are big bluestem, sand bluestem, and sandreed. Short grasses are buffalograss (*Buchloe dactyloides*) and blue grama. The vegetation is similar to that on the Deep Sand site, except that blue grama, buffalograss, and the mid grasses are more abundant.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,800 pounds per acre in favorable years and 1,000 pounds in unfavorable years. If the site is in poor condition, the yield varies between

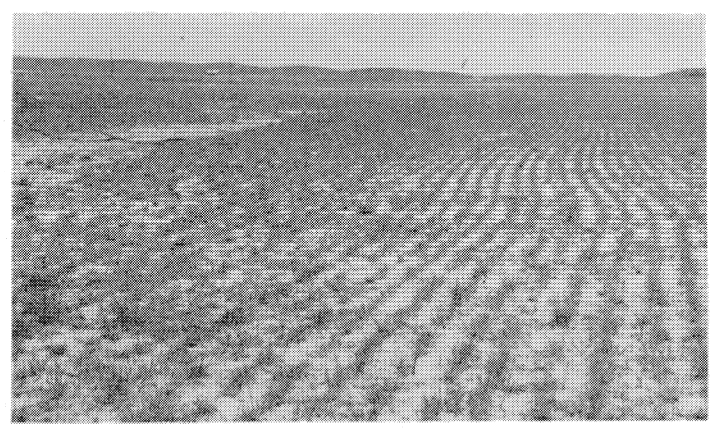

Figure 14.—This part of the Sandy Plains range site has been taken out of cultivation and reseeded to pasture grasses. It provides grazing in winter and early in spring.

800 pounds in favorable years and 500 pounds in unfavorable years.

LOAMY PLAINS RANGE SITE

This range site (fig. 15) occurs mainly in the eastern part of the survey area. Wind erosion and water erosion are hazards. The soils in this site are—

Baca loam, 3 to 5 percent slopes.
Christianburg sandy loam, 0 to 3 percent slopes.
Fort Collins loam, 0 to 3 percent slopes.
Nunn loam, 0 to 3 percent slopes.
Nunn loam, 3 to 5 percent slopes, severely eroded.
Nunn sandy loam, 0 to 3 percent slopes.
Platner loam, 0 to 1 percent slopes.
Platner loam, 1 to 3 percent slopes.
Platner loam, 3 to 5 percent slopes.
Platner loam, 5 to 9 percent slopes.
Stoneham loam, 1 to 3 percent slopes.
Stoneham loam, 3 to 5 percent slopes.
Ulm loam, 1 to 5 percent slopes.
Ulm-Beckton complex, 3 to 9 percent slopes (Ulm soil).
Weld loam, 0 to 1 percent slopes.
Weld loam, 1 to 3 percent slopes.
Weld loam, 3 to 5 percent slopes.
Wiley and Colby soils, 3 to 5 percent slopes.

About three-fourths of the herbage on this site is blue grama, and its abundance distinguishes this site from others. Buffalograss is also plentiful. Such mid grasses as needle-and-thread, western wheatgrass (*Agropyron smithii*), and junegrass (*Koeleria cristata*) make up part of the cover. Little bluestem and sideoats grama grow in eroded areas on the steeper slopes.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,500 pounds per acre in favorable years and 1,000 pounds in unfavorable years. If the site is in poor condition, the yield varies between 400 pounds in favorable years and 300 pounds in unfavorable years.

Figure 15.—**This part of the Loamy Plains range site was formerly cultivated but has been reseeded to blue grama, which provides excellent grazing for livestock and protects the soils against erosion. This area is near Matheson.**

CLAYEY PLAINS RANGE SITE

This range site is on slopes above draws and in lower places in the northern part of the survey area. Deep gullies are common in the swales. This site is more susceptible to erosion than the Loamy Plains site because the soils take water more slowly and runoff is greater. The soils in this site are—

Christianburg clay, 3 to 5 percent slopes.
Kutch clay, 1 to 5 percent slopes.
Kutch clay, 5 to 15 percent slopes.
Kutch clay, 5 to 15 percent slopes, severely eroded.
Renohill clay loam.
Renohill complex, 3 to 15 percent slopes, eroded.
Slickspot-Kutch complex, 3 to 9 percent slopes (Kutch soil only).
Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded (Kutch soil only).

About half of the vegetation is blue grama. Other grasses are western wheatgrass, buffalograss, and galleta (*Hilaria jamesii*). Browse plants, such as fourwing saltbush (*Atriplex canescens*), rabbitbrush (*Chrysothamnus lanceolatus*), and winterfat (*Eurotia lanata*) grow in scattered stands. Alkali sacaton (*Sporobolus airoides*) and greasewood (*Sarcobatus vermiculatus*) also grow on this site.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,200 pounds per acre in favorable years and 400 pounds in unfavorable years. If the site is in poor condition, the yield varies between 400 pounds in favorable years and 100 pounds in unfavorable years.

LOAMY SLOPES RANGE SITE

This range site is adjacent to the Loamy Plains site in most places. If the vegetation deteriorates, sheet and gully erosion are likely because the slopes are steep and the soils are unstable. The slopes are not smooth but have a catstep appearance. The soils in this site are—

Baca loam, 5 to 15 percent slopes.
Baca complex, 5 to 15 percent slopes, eroded.
Midway-Bainville complex.
Midway-Bainville complex, eroded.
Midway-Ulm complex.
Ulm loam, 5 to 12 percent slopes.
Ulm loam, 5 to 12 percent slopes, severely eroded.
Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded.
Wiley and Colby soils, 5 to 18 percent slopes.

The vegetation on this site looks like bunchgrass, but it is composed mostly of such mid grasses as sideoats grama, little bluestem, and western wheatgrass. About 35 to 40 percent is blue grama.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,800 pounds per acre in favorable years and 800 pounds in unfavorable years. If the site is in poor condition, the yield varies between 600 pounds in favorable years and 300 pounds in unfavorable years.

SHALE BREAKS RANGE SITE

This range site occurs in scattered spots throughout the survey area. The plant cover is sparse, and runoff is fairly rapid. The soils are—

Lismas clay.
Lismas clay, eroded.
Midway-Ulm complex, severely eroded.
Rough broken land.
Terry-Lismas complex (Lismas soils only).
Terry-Lismas complex, severely eroded (Lismas soils only).
Yoder-Truckton-Lismas complex (Lismas soils only).

The vegetation is mainly mid grasses, such as western wheatgrass, sideoats grama, and little bluestem. Blue grama is of secondary importance.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,400 pounds per acre in favorable years and 800 pounds in unfavorable years. If the site is in poor condition, the yield varies between 400 pounds in favorable years and 300 pounds in unfavorable years.

SANDSTONE BREAKS RANGE SITE

This range site occupies rough ridges and steep, broken slopes throughout the northeastern part of the survey area. The soils in this site are—

- Terry-Lismas complex (Terry soil only).
- Terry-Lismas complex, severely eroded (Terry soil only).
- Terry-Vebar-Tullock complex, 5 to 25 percent slopes (Tullock soil only).

This is one of the more productive breaks range sites. The vegetation consists of mid and tall grasses, mainly sandreed, big bluestem, sand bluestem, indiangrass (*Sorghastrum nutans*), switchgrass, little bluestem, and sideoats grama.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,500 pounds per acre in favorable years and 700 pounds in unfavorable years. If the site is in poor condition, the yield varies between 500 pounds in favorable years and 300 pounds in unfavorable years.

GRAVEL BREAKS RANGE SITE

This range site occurs in the western part of the survey area. It consists entirely of Gravelly land. The slopes are gentle to steep. The soils take in water well.

The vegetation on this site is mainly little bluestem, sideoats grama, switchgrass, and blue grama. It has the appearance of bunchgrass.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,400 pounds per acre in favorable years and 800 pounds in unfavorable years. If the site is in poor condition, the yield varies between 600 pounds in favorable years and 300 pounds in unfavorable years.

OVERFLOW RANGE SITE

This site is along the banks of streams. It is made up of a mixture of moderately fine textured to coarse-textured soils. These soils are so intermingled that it was not practical to map them separately. The finer textured soils form a natural system for water spreading. They are moderately deep and have good water-holding capacity. The coarser textured soils take in water rapidly, but they have low water-holding capacity. The soils in this site are—

- Loamy alluvial land.
- Sandy alluvial land.

The vegetation includes western wheatgrass, switchgrass, sideoats grama, alkali sacaton, sand bluestem, sandreed, little bluestem, indiangrass, blue grama, and buffalograss.

If this site is in excellent condition, the yield of air-dry herbage varies between 3,000 pounds per acre in favorable years and 1,500 pounds in unfavorable years. If the site is in poor condition, the yield varies between 1,500 pounds in favorable years and 400 pounds in unfavorable years.

SANDY MEADOW RANGE SITE

This site occurs in sandy places adjacent to river bottoms. It consists entirely of Wet alluvial land. The soils are mottled because the water table is continuously high. The areas are small but highly productive. They are normally used for hay.

The vegetation is switchgrass, indiangrass, sand bluestem, and prairie cordgrass (*Spartina pectinata*). Little bluestem grows in the drier areas. Western wheatgrass, alkali sacaton, and saltgrass (*Distichlis stricta*) grow in areas where the soil is saline.

If this site is in excellent condition, the yield of air-dry herbage varies between 3,000 pounds per acre in favorable years and 1,500 pounds in unfavorable years. If the site is in poor condition, the yield varies between 1,500 pounds in favorable years and 600 pounds in unfavorable years.

SALT FLATS RANGE SITE

This range site occurs in swales or in flat areas on stream terraces. Slickspots are common. The water table is so low that plants do not benefit from it. Infiltration and permeability are slow, and evaporation is rapid. The soils in this site are—

- Arvada loam, 0 to 3 percent slopes.
- Arvada complex, 0 to 3 percent slopes, eroded.
- Christianburg clay, 0 to 3 percent slopes.
- Christianburg clay, 0 to 3 percent slopes, severely eroded.
- Slickspot-Kutch complex, 3 to 9 percent slopes (Slickspot soil only).
- Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded (Slickspot soil only).
- Ulm-Beckton complex, 3 to 9 percent slopes (Beckton soil only).

These soils contain enough salt that the vegetation is limited to salt-tolerant plants. These are greasewood, saltgrass, alkali sacaton, western wheatgrass, galleta, and alkali seepweed (*Suaeda fruticosa*). Kochia (*Kochia scoparia*) is a common invader.

If this site is in excellent condition, the yield of air-dry herbage varies between 2,000 pounds per acre in favorable years and 800 pounds in unfavorable years. If the site is in poor condition, the yield varies between 500 pounds in favorable years and 200 pounds in unfavorable years.

SANDY GRASSLAND RANGE SITE

This is the major range site in the western part of the survey area. It is one of the more productive upland sites. With an equal supply of moisture, it will yield more forage per acre than the Sandy Plains site. The soils are sandy throughout and take water well. The soils in this site are—

- Bresser sandy loam, 1 to 3 percent slopes.
- Bresser sandy loam, 3 to 5 percent slopes.
- Bresser sandy loam, 5 to 9 percent slopes.
- Bresser sandy loam, 9 to 15 percent slopes.
- Bresser complex, 3 to 5 percent slopes, eroded.
- Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes.
- Eastonville loamy sand, 0 to 3 percent slopes.
- Eastonville loamy sand, 3 to 5 percent slopes.
- Truckton sandy loam, 1 to 3 percent slopes.
- Truckton sandy loam, 3 to 5 percent slopes.
- Truckton sandy loam, 5 to 20 percent slopes.
- Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded.
- Yoder-Truckton-Lismas complex (Truckton soil only).

This site is suited to prairie grasses. Tall grasses predominate, mainly sandreed, sand bluestem, switchgrass,

and mountain muhly (*Muhlenbergia montana*). There is some indiangrass, sideoats grama, little bluestem, blue grama, and junegrass. Wheatgrass also grows on this site. Mountain muhly is better suited to these soils than to the soils of the Sandy Plains site.

If this site is in excellent condition, the yield of air-dry herbage varies between 2,500 pounds per acre in favorable years and 1,500 pounds in unfavorable years. If the site is in poor condition, the yield varies between 1,200 pounds in favorable years and 600 pounds in unfavorable years.

GRAVELLY OUTWASH RANGE SITE

This range site occurs in the western part of the survey area, within and adjacent to the Sandy Grassland site. The soils are gravelly. The soils on this site are—

Yoder gravelly sandy loam.
Yoder-Truckton-Lismas complex (Yoder soil only).

The vegetation on this site is similar to that on the Sandy Grassland range site. The soils are suited to mountain muhly, slender wheatgrass (*Agropyron trachycaulum*), sideoats grama, little bluestem, western wheatgrass, switchgrass, junegrass, and bluegrass. Yields of herbage from these soils are greater than those from the Gravel Breaks range site. Also, this site is better suited to cool-season grasses than the Gravel Breaks site.

If this site is in excellent condition, the yield of air-dry herbage varies between 1,500 pounds per acre in favorable years and 900 pounds in unfavorable years. If the site is in poor condition, the yield varies between 500 pounds in favorable years and 300 pounds in unfavorable years.

Practices for rangeland

The basic practices necessary for obtaining continuous high yields of native forage are discussed in the following pages. If the rangeland was formerly used for purposes other than pasture, it may be necessary to supplement these basic practices with brush control, reseeding, contour furrowing, chiseling, and pitting.

Control of grazing.—Control of grazing is the most important range management practice. Without it, other practices are not effective. If grazing is properly controlled, the range will continue to be productive and it will be protected against erosion.

The condition of the one, two, or three key plants on a given site is the guide to proper range use. The key plants are those that make up the major part of the forage. If these plants lose vigor, do not produce seed, or are displaced by less desirable plants, the intensity of grazing should be adjusted. A change to a different kind of livestock or a change in the season of use is sometimes necessary.

Livestock naturally graze an area unevenly. Even distribution of grazing can be encouraged by seeing that supplies of water for the stock are well distributed (fig. 16) and by placing salt in areas that are lightly grazed. Fencing between different range sites or between areas in different stages of range condition may be advisable. Fences need to be located so that they will not interfere unnecessarily with the normal movement of livestock and will prevent the trapping of stock in fenced corners during snowstorms.

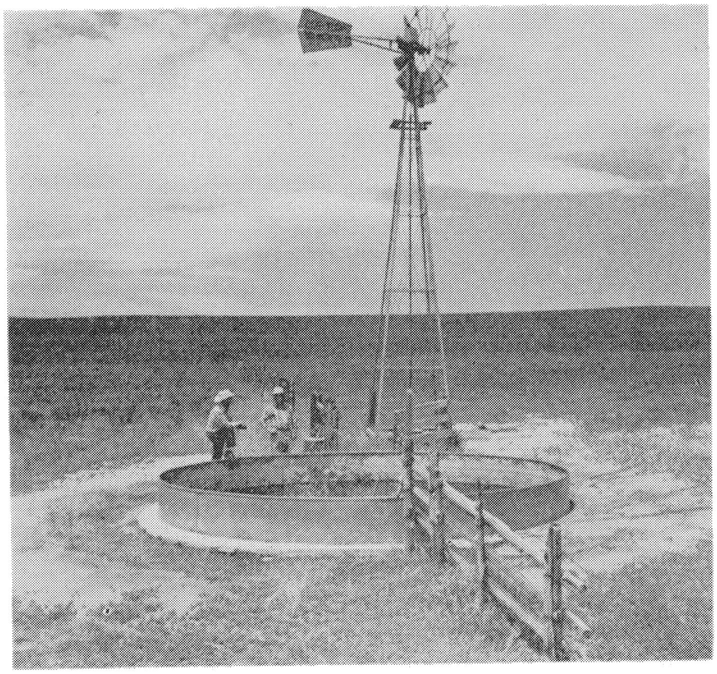

***Figure 16.*—Stockwater supplies, properly spaced, help to distribute grazing uniformly. This windmill and storage tank provide clear water. A band of concrete 18 inches wide makes a base for cattle to stand on while drinking and prevents the formation of bog holes.**

Deferred grazing.—The practice of moving livestock from one pasture to another during the season when the major plants are in active growth allows the key plants to build up vigor, strengthen their root systems, and produce seed. If a ranch has three or four pastures, grazing can be rotated so that one pasture is rested while the others are grazed.

Control of brush and weeds.—Native grasses crowd out weeds on well-managed range. Sand sagebrush and other woody plants can usually be controlled by the use of foliage sprays. Mowing, beating, and one-waying are slower, more expensive, and generally less effective than spraying. Using a big disk one-way has the advantage, however, of smoothing out hummocks that form around brush crowns.

Sagebrush provides some forage for livestock and gives some protection to sandy soils, but grass grows better if the competition from sagebrush is reduced. If the grass cover is sparse, the areas should be seeded to suitable native grasses. Whether seeded or not, growing-season rest is needed immediately after brush is removed to give the grass a chance to develop a vigorous stand and to produce seed. Moderate grazing in winter is not ordinarily harmful, since the plants are less likely to be damaged while dormant.

Range seeding.—Rangeland that has been plowed out of native cover can be seeded to suitable native grasses. Blue grama is well suited to the clay loams and loams; the taller grasses are better suited to the sandy soils. Sideoats grama grows well on the shallow, limy, hardland soils. A mixture of sideoats grama, blue grama, and western wheatgrass can be seeded on the clay loams and loams. A mixture of little bluestem, sand bluestem,

switchgrass, western wheatgrass, blue grama, and side-oats grama is suggested for sandy soils. Stubble of drilled grain, sorghum, or sudangrass is good mulch for a seedbed. The grass seed can be drilled into the stubble without any additional cultivation, and the litter protects the seedlings until the grass is firmly established.

Contour furrowing, chiseling, and pitting.—These practices retard runoff and should be applied only to break up sod-bound soils. Furrows, chisel marks, or pits check runoff and allow water to soak into the soil. Water stored in the subsoil provides moisture and encourages the growth of established plants and seedlings.

Windbreaks [3]

The native cover in most of the survey area is grass. The climate is too dry and too cold in winter for good natural growth of trees, and wooded areas are scarce.

There are small natural stands of cottonwood and willow on areas of Sandy alluvial land, Loamy alluvial land, and Wet alluvial land. These stands are along East Bijou Creek, Big Sandy Creek, Horse Creek, Rush Creek, and some of the tributaries of these major drainageways. Such wooded areas are highly valued as protection for livestock during severe blizzards in winter.

Small scattered patches of one-seed juniper and ponderosa pine grow on areas of Rough broken land. The stands are not so dense as normal, and the trees have no commercial value.

[3] By W. S. SWENSON, woodland conservationist, Soil Conservation Service.

If windbreaks and shelterbelts are planted, they return substantial benefits to landowners. They protect homes against cold, wintry winds and reduce the cost of heating. They protect gardens, provide shade in summer, and enhance the beauty of the home and its surroundings. They control the drifting of snow in winter and protect livestock. They provide food and cover for wildlife and a habitat for birds.

Great care is needed in selecting locations for windbreak plantings with respect to buildings, roads, and other farm improvements. Care is also needed in selecting trees that are adapted to the climate and suited to the soils at the planting site.

Evergreens are the most desirable trees for windbreaks because they are long lived and they resist damage by snow, wind, insects, and disease. Year-old nursery plants that have been grown in tar-paper pots are the most successful. Evergreens grow much more slowly than broadleaf trees or shrubs for the first few years. For this reason, they should be planted in two or more single rows, and separate rows of the faster growing but shorter lived broadleaf trees (fig. 17) should be planted to provide protection while the evergreens are growing.

Assistance in planning windbreaks is available through the local office of the Soil Conservation Service, from Agricultural Extension Service, and from the Colorado State Forest Service at Fort Collins.

Management and care of trees.—The kinds of trees and shrubs that are adapted to the climate of this survey area are limited, and cultivation (fig. 18) is impor-

Figure 17.—The windbreak at the right of the picture is growing on Bresser sandy loam, 5 to 9 percent slopes. It is about 20 years old. The planting at the left of the picture is on Loamy alluvial land and is about 9 years old. This farm is approximately 6 miles south of Agate.

Figure 18.—Twenty-year-old Rocky Mountain juniper growing on Bresser sandy loam, 5 to 9 percent slopes. The trees are 10 to 12 feet high and were planted on the contour. Clean cultivation has kept these trees healthy and vigorous.

tant if trees are to survive and grow. Cultivation should be timely so that the planting is kept free of weeds and grass, which compete with tree roots for the limited supply of moisture. Cultivation also reduces the hazard of fire, which would probably kill the trees.

The young trees need protection from livestock, and fencing is important if grazing animals are pastured nearby. Rabbits, mice, deer, and antelope may damage the plantings during the first few years, and a suitable repellent should be applied each fall. The trees should be examined occasionally for diseases and harmful insects.

Pruning should be confined to removing dead limbs and branches. Pruning does not stimulate growth in height; it only decreases the density of the planting and results in poorer protection against wind and drifting snow.

Watering newly planted trees provides needed moisture and helps to set the soil more firmly around the roots. During the first year or two, it is most important to see that the uppermost 6 inches of the soil does not become too dry.

Windbreak groups

The soils of this survey area have been placed in five windbreak groups. The soils in each group are suitable for similar species, and the trees make similar response to good management.

Windbreak ratings of soils and species suitability.—Table 4 lists the species of trees that are suitable for the soils of groups 1, 2, and 3. The soils of groups 4 and 5 are generally unsuited to trees and are not rated in this table. The table also gives the height that trees of each species will probably reach at about 20 years of age, and the survival rate that can reasonably be expected after 1 or 2 years, provided replanting is done if required. The rating in the "Vigor" column refers to the density of the foliage, freedom from disease or damage by insects, and the general appearance of the tree. The ratings in this table are based on general observation of well-tended plantings.

WINDBREAK GROUP 1

The soils in this group are deep, medium-textured or moderately fine textured, and well drained. They are free of injurious salts. Their moisture intake is moderate, and their water-holding capacity is very good. The soils are—

Baca loam, 3 to 5 percent slopes.
Baca loam, 5 to 15 percent slopes.
Baca complex, 5 to 15 percent slopes, eroded.
Fort Collins loam, 0 to 3 percent slopes.
Midway-Ulm complex (Ulm soils only).
Nunn loam, 0 to 3 percent slopes.
Nunn loam, 3 to 5 percent slopes, severely eroded.
Nunn sandy loam, 0 to 3 percent slopes.
Platner loam, 0 to 1 percent slopes.
Platner loam, 1 to 3 percent slopes.
Platner loam, 3 to 5 percent slopes.
Platner loam, 5 to 9 percent slopes.
Stoneham loam, 1 to 3 percent slopes.
Stoneham loam, 3 to 5 percent slopes.
Ulm loam, 1 to 5 percent slopes.
Ulm loam, 5 to 12 percent slopes.
Ulm loam, 5 to 12 percent slopes, severely eroded.
Ulm-Beckton complex, 3 to 9 percent slopes (Ulm soils only).
Weld loam, 0 to 1 percent slopes.
Weld loam, 1 to 3 percent slopes.
Weld loam, 3 to 5 percent slopes.
Wiley and Colby soils, 3 to 5 percent slopes (both soils).
Wiley and Colby soils, 5 to 18 percent slopes (both soils).

Trees that are adapted to the climate (fig. 19) grow well on these soils, but they may be difficult to establish. Good seedbed preparation, control of weeds, and supplemental watering help to establish the young plants. If the slope is more than 5 percent, the trees should be planted on the contour or behind terraces. The rows should be at least 20 feet apart, so that each tree will get enough moisture and will have room for development, and so that cultivation between the rows will be possible.

TABLE 4.—*Windbreak ratings of soils and species suitability*

Suitable species	Soils of group 1			Soils of group 2			Soils of group 3		
	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor
	Feet	*Percent*		*Feet*	*Percent*		*Feet*	*Percent*	
Ponderosa pine	18–20	80	Good	20–22	90	Good	12–15	75	Fair.
Rocky Mountain juniper	8–12	80	Good	10–14	90	Good	8–10	80	Good.
Siberian elm	20–25	90	Fair	25–30	95	Good	15–20	80	Fair.
Russian-olive	16–20	85	Fair	16–20	90	Good	12–18	80	Poor.
Common lilac	6–8	90	Good	6–8	90	Good	5–7	85	Fair.
Squawbush (Quailbush)	5–7	90	Good	5–7	90	Good	4–6	85	Good.

Figure 19.—**In the foreground is 8-year-old Rocky Mountain juniper, and in the background is 20-year-old ponderosa pine. The pines are about 20 feet tall. These trees are growing on Weld loam, 0 to 1 percent slopes, in an area south of Agate.**

Wind, blowing soil, and drought are the chief hazards to newly planted trees. To overcome these hazards, the soils should be left in summer fallow for a season before planting. Runoff should be diverted from adjacent areas onto the planting site. It may be desirable to grow cover crops between rows of young trees the first 2 or 3 years because plant cover helps to reduce the temperature of the uppermost few inches of soil, checks wind erosion, and lessens the hazard of water erosion by slowing down runoff.

WINDBREAK GROUP 2

The soils in this group are deep and well drained. They do not contain harmful salts. Infiltration is rapid, but the water-holding capacity is low. The soils are—

Blakeland loamy sand.
Eastonville loamy sand, 0 to 3 percent slopes.
Eastonville loamy sand, 3 to 5 percent slopes.
Terry-Vebar-Tullock complex, 5 to 25 percent slopes (all soils).
Vebar loamy fine sand, 3 to 5 percent slopes.
Vebar loamy fine sand, 5 to 20 percent slopes.

Evergreens are better suited to these soils than broadleaf trees because they adapt better to the dry climate. Controlling weeds lessens the competition for moisture. Fencing along the northern and western sides of the planting area helps to protect new plantings from drifting snow in winter and also channels additional moisture into the planting area. If the slope is more than 5 percent, the trees should be planted on the contour. The rows should be at least 20 feet apart, so that each tree will get enough moisture and will have room for development, and so that cultivation between the rows will be possible.

Soil blowing, a serious hazard on these soils, generally can be checked by leaving strips of vegetation or stubble between the rows of trees.

WINDBREAK GROUP 3

The soils in this group are deep or moderately deep and are well drained. They are mostly of sandy or loamy texture and are generally nonsaline. There are a few small areas of shallow, saline, clayey soils, but the total acreage of such soils is not significant. The soils of windbreak group 3 are—

Ascalon sandy loam, 1 to 3 percent slopes.
Ascalon sandy loam, 3 to 5 percent slopes.
Ascalon sandy loam, 5 to 9 percent slopes.
Ascalon sandy loam, 9 to 15 percent slopes.
Ascalon complex, 1 to 3 percent slopes, eroded.
Ascalon complex, 3 to 5 percent slopes, eroded.
Bresser sandy loam, 1 to 3 percent slopes.
Bresser sandy loam, 3 to 5 percent slopes.
Bresser sandy loam, 5 to 9 percent slopes.
Bresser sandy loam, 9 to 15 percent slopes.
Bresser complex, 3 to 5 percent slopes, eroded.
Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes (all soils).
Christianburg sandy loam, 0 to 3 percent slopes.
Platner-Ascalon sandy loams, 0 to 3 percent slopes (both soils).
Platner-Ascalon sandy loams, 3 to 5 percent slopes (both soils).
Stoneham sandy loam, 1 to 5 percent slopes.
Stoneham sandy loam, 5 to 18 percent slopes.
Stoneham complex, 1 to 5 percent slopes, eroded.
Terry fine sandy loam, 5 to 20 percent slopes.
Terry-Lismas complex (Terry soils only).
Truckton sandy loam, 1 to 3 percent slopes.
Truckton sandy loam, 3 to 5 percent slopes.
Truckton sandy loam, 5 to 20 percent slopes.
Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded (all soils).
Yoder gravelly sandy loam.
Yoder-Truckton-Lismas complex (Yoder and Truckton soils).

Drought, wind erosion, and water erosion are the chief hazards. Only those soils that are more than 30 inches deep are suitable for trees. If the slope is more than 5 percent, trees should be planted on the contour or behind terraces. Trees should not be planted where the slope is more than 9 percent, unless precautions are taken to avoid starting erosion.

WINDBREAK GROUP 4

This group is made up of alluvial deposits that are wet or moderately wet because they have poor internal drainage. In a few places they are saline. The slope range is 1 to 3 percent. The group consists of—

Loamy alluvial land.
Sandy alluvial land.
Wet alluvial land.

These land types, in their natural state, are not suited to trees. Planted stock does not grow well, and the mortality rate is high.

WINDBREAK GROUP 5

The soils in this group are not generally suitable for trees, because they are either steep or shallow, or they are highly saline or alkaline, or else they are too clayey. The soils are—

Arvada loam, 0 to 3 percent slopes.
Arvada complex, 0 to 3 percent slopes, eroded.
Badlands.
Breaks-Alluvial land complex (all soils).
Christianburg clay, 0 to 3 percent slopes.
Christianburg clay, 0 to 3 percent slopes, severely eroded.
Christianburg clay, 3 to 5 percent slopes.
Gravelly land.
Kutch clay, 1 to 5 percent slopes.
Kutch clay, 5 to 15 percent slopes.
Kutch clay, 5 to 15 percent slopes, severely eroded.
Lismas clay.
Lismas clay, eroded.
Midway-Bainville complex (both soils).
Midway-Bainville complex, eroded (both soils).
Midway-Ulm complex (Midway soils only).

Midway-Ulm complex, severely eroded (both soils).
Renohill clay loam.
Renohill complex, 3 to 15 percent slopes, eroded (all soils).
Riverwash.
Rough broken land.
Rough gullied land.
Slickspot-Kutch complex, 3 to 9 percent slopes (both soils).
Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded (both soils).
Terry-Lismas complex (Lismas soils only).
Terry-Lismas complex, severely eroded (both soils).
Ulm-Beckton complex, 3 to 9 percent slopes (Beckton soils only).
Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded (both soils).
Yoder-Truckton-Lismas complex (Lismas soils only).

Windbreaks can be established in some areas of these soils, but each site ought to be examined individually before trees are planted.

Wildlife

The eastern part of Elbert County is a short-grass prairie that once supported deer and large herds of buffalo and antelope. Before the area was settled, wolves and coyotes were numerous. Songbirds, rabbits, badgers, and other small animals also inhabited the area. Waterfowl migrated through but, because of the limited water supply, did not establish a habitat.

Plowing and other activities of man have been unfavorable to some kinds of wildlife but favorable to others. Wolves and buffaloes have disappeared, but many antelopes, coyotes, rabbits, badgers, and raccoons remain, and also a few deer. Bobcats can still be seen occasionally in the more isolated breaks areas. Pheasants now frequent areas where grain is cultivated, and scaled quail inhabit the rougher areas. Waterfowl, doves, songbirds, and other birds have become more numerous since the area was first settled, and small animals have also increased in numbers. Muskrats inhabit the few spring-fed marsh areas.

General good management of areas where grain and native grasses are the main crops improves the habitat for most kinds of wildlife.

Keeping a cover of permanent vegetation on soils that are not suited to cultivation and managing the grass to assure natural reseeding improves the habitat for antelope, quail, deer, doves, and other kinds of wildlife.

Odd corners in cultivated fields or pastures and areas around ponds are suitable for planting trees, shrubs, grasses, legumes, and other plants that provide food and cover for wildlife. Suitable food plants are sunflowers, wheat, sorghum, millet, and corn. The landowner should plant the kinds of vegetation that will favor the species of wildlife he wants to encourage.

Planting trees and shrubs to protect farmsteads, fields, and livestock against wind and water erosion also benefits wildlife. Russian-olive, squawbush, and wild plum are suitable for windbreaks and also provide food and cover for wildlife.

Stockwater ponds and other watering places are of major importance to all wildlife. Many sites in this area are suitable for fishponds. Some of the ponds that have been established are stocked with trout. Warm-water ponds are better suited to bass and bluegill. Most of the ponds are frequented by wild ducks.

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A cropping system that includes conservation measures, such as stubble mulching, provides food and cover for pheasants, quail, and other desirable kinds of wildlife.

Protection from fire and from grazing is all that is necessary to make some areas suitable as a habitat for quail and other kinds of wildlife.

Assistance in planning and applying special practices to improve wildlife habitats can be obtained through the local office of the Soil Conservation Service or from the Game and Fish Department of the State government.

Engineering

Some soil properties are of special interest to engineers because they affect the suitability of the soil for building sites or impose limitations or special requirements for use of the soil in construction.

Many soil characteristics affect the construction, operation, and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion-control structures (fig. 20), irrigation and drainage systems, and sewage-disposal systems. The soil properties most important to the engineer are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, dispersion, grain size, plasticity, depth of productive soil, and reaction. Topography, water-holding capacity, and depth to the water table and to bedrock are also important.

The information in this report can be used to—

1. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and small erosion-control structures.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
3. Locate probable sources of sand, gravel, or rock for use in construction.
4. Aid in selecting and developing sites for industrial, business, residential, and recreational purposes.

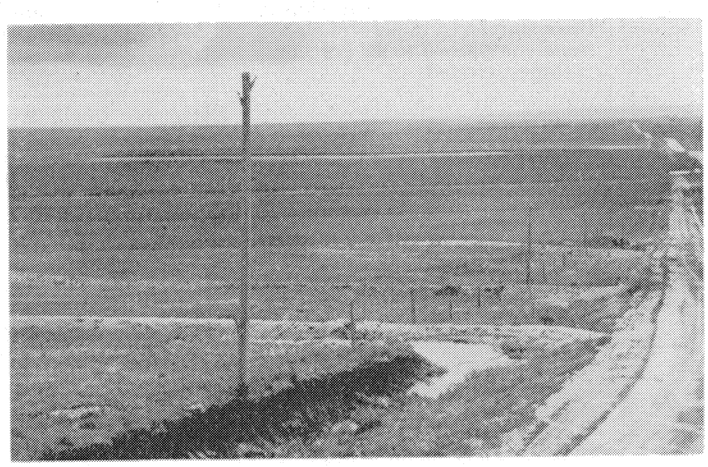

Figure 20.—**Diversions channel water from the road to the range. This is part of a county project to control floodwaters.**

5. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in designing and maintaining such structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs, for the purpose of making maps and reports that can be used readily by engineers.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized, however, that these interpretations may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depth of layers here reported. Even in these situations, the soil map and the interpretations are useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by the soil scientist may not be familiar to the engineer, and some words, for example, soil, clay, silt, and sand, have special meanings in soil science. Most of these terms are defined in the Glossary at the back of the report.

Estimated properties of the soils and engineering interpretations

This section contains two tables. Table 5 gives brief descriptions of the soils and estimates of their physical

TABLE 5.—*Brief descriptions of the soils and estimated*

[Physical and chemical properties of the surface layer have not been estimated,

Map symbol	Mapping unit	Description	Hydrologic group	Depth from surface (typical profile)	Classification
					USDA texture
				Inches	
AaA	Arvada loam, 0 to 3 percent slopes.	1 to 4 inches of loam, over about 16 inches of clay, over 18 inches of heavy clay loam, underlain by alluvium derived from dark-gray shale and fine-grained sandstone; on stream terraces and alluvial fans.	D	4 to 20	Clay
AcB2	Arvada complex, 0 to 3 percent slopes, eroded.			20 to 48	Clay loam
AnB	Ascalon sandy loam, 1 to 3 percent slopes.	2 to 8 inches of sandy loam, over 12 to 18 inches of sandy clay loam, grading to calcareous sandy loam that extends to a depth of 4 feet or more.	B	7 to 19	Sandy clay loam
AnC	Ascalon sandy loam, 3 to 5 percent slopes.			19 to 46+	Sandy loam
AnD	Ascalon sandy loam, 5 to 9 percent slopes.				
AnE	Ascalon sandy loam, 9 to 15 percent slopes.				
ApB2	Ascalon complex, 1 to 3 percent slopes, eroded.				
ApC2	Ascalon complex, 3 to 5 percent slopes, eroded.				
BaC	Baca loam, 3 to 5 percent slopes.	2 to 5 inches of loam or silt loam, underlain by 18 to 30 inches of silty clay loam that grades into calcareous loess.	B	5 to 60	Silty clay loam to loam.
BaE	Baca loam, 5 to 15 percent slopes.				
BcE2	Baca complex, 5 to 15 percent slopes, eroded.				
Bd	Badlands.	Extremely rough areas; little development of profile; sandstone, siltstone, and shale are exposed; runoff is very rapid, and erosion is active; all properties variable.			
Be	Blakeland loamy sand.	5 feet or more of sandy loam to sand.	A	0 to 60+	Sandy loam to sand
Bk	Breaks-Alluvial land complex.	All properties variable.			
BmB	Bresser sandy loam, 1 to 3 percent slopes.	3 to 8 inches of sandy loam, underlain by 2 to 3 feet of sandy clay loam.	B	3 to 29	Sandy clay loam
BmC	Bresser sandy loam, 3 to 5 percent slopes.			29+	Heavy sandy loam
BmD	Bresser sandy loam, 5 to 9 percent slopes.				
BmE	Bresser sandy loam, 9 to 15 percent slopes.				
BrC2	Bresser complex, 3 to 5 percent slopes, eroded.				

See footnotes at end of table.

and chemical properties. Table 6, page 48, gives evaluations of the suitability of the soils for various uses and describes specific characteristics of each soil series that affect the design of structures and the application of engineering practices. The interpretations in table 6 are based on the estimates in table 5, on available test data, and on field experience.

The hydrologic grouping (see table 5) is based on the runoff-producing characteristics of the soils. The soils are classed as A, B, C, or D.[4] In hydrologic group A are soils that have the lowest runoff potential. They include deep sands that contain very little silt or clay. In hydrologic group B are soils that are less deep than those in group A but have an above-average rate of infiltration after thorough wetting. In hydrologic group C are shallow soils or soils that contain considerable clay and colloidal material. These soils have a below-average rate of infiltration after thorough wetting. In hydrologic group D are mostly clays that have high shrink-swell potential or shallow soils that have nearly impermeable horizons near the surface.

Dispersion as used in table 5 refers to the degree to which particles smaller than 0.005 millimeter are separate or dispersed. It is to be distinguished from the single-grain, or unaggregated, condition of clean sand. Dispersed soils are likely to slick over when wet and to crust when dry. Soils in which the exchangeable sodium content is more than 15 percent are likely to be dispersed, and so are acid, silty soils that developed under condi-

[4] Engineering Handbook, Hydrology, Supplement A, Sec. 4, Soil Conservation Service, USDA.

physical and chemical properties of significant layers

as these layers are thin and are of only limited significance in engineering work]

Classification—Con.		Percentage passing sieve—			Permeability	Water-holding capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
Unified [1]	AASHO [2]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
					Inches per hour	*Inches per inch of soil*	*pH*			
CH	A-7	100	100	80 to 90	0.2 to 0.5	0.25	8.0 to 9.0	Severe	High	High.
CL	A-6 or A-7.	100	100	70 to 90	0.5 to 2.5	0.15 to 0.25.	7.4 to 8.4	Severe	High	High.
SC or CL	A-6	100	100	35 to 70	1.5 to 2.5	0.18	7.0 to 7.9	Slight	Low	Low to moderate.
SC	A-2	100	100	10 to 25	2.5 to 5.0	0.07	7.9 to 8.4	Slight	Low	Low to moderate.
CL or ML	A-4	100	100	85 to 95	0.8 to 2.5	0.2	7.4 to 8.4	Moderate	Low	Low to moderate.
SP-SM or SM.	A-2 or A-3.	100	85 to 95	5 to 15	5.0 to 10.0	0.08	6.6 to 7.3	None	Low	Low.
SC	A-2 or A-6.	100	100	30 to 50	0.8 to 2.5	0.2	6.6 to 7.8	Slight	Low	Low to moderate.
SP-SM or SM.	A-2	100	100	5 to 25	2.5 to 5.0	0.08	6.6 to 7.8	Slight	Low	Low.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Mapping unit	Description	Hydrologic group	Depth from surface (typical profile)	Classification
					USDA texture
				Inches	
BtD	Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes.	Bresser: See description of Bresser soils (BmB, BmC, BmD, BmE, BrC2). Truckton: See description of Truckton soils (TkB, TkC, TkE). Blakeland: See description of Blakeland loamy sand (Be).			
CbA CbB3 CbC ChA	Christianburg clay, 0 to 3 percent slopes. Christianburg clay, 0 to 3 percent slopes, severely eroded. Christianburg clay, 3 to 5 percent slopes. Christianburg sandy loam, 0 to 3 percent slopes.	8 to 24 inches of clay, over alternate layers of medium-textured and coarse-textured material.	D	0 to 24	Clay
EaA EaC	Eastonville loamy sand, 0 to 3 percent slopes. Eastonville loamy sand, 3 to 5 percent slopes.	7 to 17 inches of loamy sand, over light sandy loam and gravelly light sandy loam.	A	0 to 17 17 to 48+	Loamy sand Sandy loam
FcA	Fort Collins loam, 0 to 3 percent slopes.	Loam or silt loam to a depth of 60 inches.	B	0 to 60	Loam and silt loam
Gr	Gravelly land.	About 4 inches of very gravelly loam over 10 to 12 inches of very gravelly sandy loam and loamy sand, underlain by very gravelly sand.	B	0 to 20+	Very gravelly loam, sandy loam, loamy sand, and sand.
KcC KcE KcE3	Kutch clay, 1 to 5 percent slopes. Kutch clay, 5 to 15 percent slopes. Kutch clay, 5 to 15 percent slopes, severely eroded.	Clay to a depth of 3 feet or more.	D	0 to 36+	Clay
Lc Lc2	Lismas clay. Lismas clay, eroded.	4 to 10 inches of dark-gray clay, underlain by clayey shale.	D	0 to 10	Clay
Lo	Loamy alluvial land.	All properties variable.			
Mb Mb2	Midway-Bainville complex. Midway-Bainville complex, eroded.	Midway: About 24 inches of clay loam, underlain by shale. Bainville: About 14 inches of loam, underlain by interbedded siltstone, sandstone, and sandy shale.	C C	0 to 24 0 to 14	Clay loam Loam
Mu Mu3	Midway-Ulm complex. Midway-Ulm complex, severely eroded.	Midway: See description of Midway-Bainville complex (Mb, Mb2). Ulm: See description of Ulm soils (UaC, UaD, UaD3).			
NmA NmC3 NnA	Nunn loam, 0 to 3 percent slopes. Nunn loam, 3 to 5 percent slopes, severely eroded. Nunn sandy loam, 0 to 3 percent slopes.	4 to 6 inches of loam or sandy loam, underlain by 36 inches or more of clay loam.	C	6 to 60	Clay loam
PmA PmB PmC PmD	Platner loam, 0 to 1 percent slopes. Platner loam, 1 to 3 percent slopes. Platner loam, 3 to 5 percent slopes. Platner loam, 5 to 9 percent slopes.	3 to 8 inches of loam, underlain by heavy clay loam; below 20 inches the soil grades to sandy clay loam or coarser material.	B	8 to 40	Clay loam

See footnotes at end of table.

physical and chemical properties of significant layers—Continued

Classification—Con.		Percentage passing sieve—			Permea-bility	Water-holding capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
Unified [1]	AASHO [2]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
					Inches per hour	*Inches per inch of soil*	*pH*			
CH	A-7	100	100	65 to 90	<0.05	0.2	8.5 to 9.0	Severe	High	High.
SP-SM or SM.	A-2 or A-3.	100	100	5 to 30	5.0 to 10.0	0.08	6.5 to 7.0	None	Low	Low.
SM	A-2	100	100	15 to 30	2.5 to 5.0	0.08	7.0 to 7.5	None	Low	Low.
ML	A-4	100	100	60 to 70	0.5 to 2.5	0.15	7.0 to 8.0	Slight	Low	Low.
GP-GM	A-1	30 to 50	20 to 30	5 to 10	2.5 to 5.0	<0.08	6.6 to 8.4	Slight	Low	Low.
CH	A-7	100	100	90 to 98	<0.05	0.20	7.4 to 8.4	Moderate to severe.	Moderate to high.	Moderate to high.
CH	A-7	100	100	90 to 98	<0.05	0.2	7.8 to 9.5	Severe	High	High.
CL	A-7 or A-6	100	100	75 to 85	0.2 to 0.8	0.2	6.6 to 7.8	Moderate to low.	Moderate	Moderate.
ML	A-4	100	100	60 to 70	0.5 to 2.0	0.15	6.5 to 7.5	Slight to moderate.	Low	Low.
CL	A-6 or A-7	100	100	55 to 70	0.2 to 0.8	0.2	7.4 to 8.4	Slight	Moderate	Moderate.
CL	A-7	100	100	55 to 70	0.2 to 0.8	0.2	6.6 to 8.4	Slight	Moderate	Moderate.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Mapping unit	Description	Hydrologic group	Depth from surface (typical profile)	Classification
					USDA texture
				Inches	
PsB	Platner-Ascalon sandy loams, 0 to 3 percent slopes.	Platner: Same as Platner soils (PmA, PmB, PmC, and PmD), except uppermost 2 to 7 inches is moderately sandy.			
PsC	Platner-Ascalon sandy loams, 3 to 5 percent slopes.	Ascalon: See description of Ascalon soils (AnB, AnC, AnD, AnE, ApB2, ApC2).	B		
Rc	Renohill clay loam.	3 to 5 inches of clay loam, over 20 to 24 inches of heavy clay loam, underlain by partly weathered clayey shale.	D	3 to 24	Clay loam or clay
ReE2	Renohill complex, 3 to 15 percent slopes, eroded.				
Rh	Riverwash.	All properties variable.			
Rn	Rough broken land.	All properties variable.			
Ro	Rough gullied land.	All properties variable.			
Sa	Sandy alluvial land.	All properties variable.			
SkD	Slickspot-Kutch complex, 3 to 9 percent slopes.	Slickspot: Deep, compact clay to a depth of 60 inches or more.	D	0 to 60	Clay
SkD3	Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded.	Kutch: See description of Kutch soils (KcC, KcE, KcE3).			
SmB	Stoneham loam, 1 to 3 percent slopes.	3 to 8 inches of loam or sandy loam, underlain by 36 to 60 inches of strongly calcareous loam; calcareous sandy and gravelly material at a depth of 30 inches or more in places.	B	0 to 60	Loam
SmC	Stoneham loam, 3 to 5 percent slopes.				
SnC	Stoneham sandy loam, 1 to 5 percent slopes.				
SnE	Stoneham sandy loam, 5 to 18 percent slopes.				
StC2	Stoneham complex, 1 to 5 percent slopes, eroded.				
TaE	Terry fine sandy loam, 5 to 20 percent slopes.	3 to 6 inches of fine sandy loam or heavy fine loamy sand over 30 to 36 inches of light fine sandy clay loam and heavy fine sandy loam, underlain by soft, fine-grained sandstone.	B	0 to 36	Fine sandy loam and light fine sandy clay loam.
Tc	Terry-Lismas complex.	Terry: See description of Terry fine sandy loam (TaE).			
Tc3	Terry-Lismas complex, severely eroded.	Lismas: See description of Lismas soils (Lc, Lc2).			
TeE	Terry-Vebar-Tullock complex, 5 to 25 percent slopes.	Tullock: About 18 inches of loamy fine sand, underlain by shaly sandstone interbedded with sandy shale.	A	0 to 18	Loamy fine sand
		Terry: See description of Terry fine sandy loam (TaE).			
		Vebar: See description of Vebar soils (VbC, VbE).			
TkB	Truckton sandy loam, 1 to 3 percent slopes.	6 to 9 inches of sandy loam, over about 12 to 15 inches of light sandy clay loam, underlain at a depth of 18 to 24 inches by 60 inches or more of noncalcareous sandy loam and loamy sand.	B	0 to 60	Sandy loam, light sandy clay loam, and loamy sand.
TkC	Truckton sandy loam, 3 to 5 percent slopes.				
TkE	Truckton sandy loam, 5 to 20 percent slopes.				
TrE2	Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded.	Truckton: See description of Truckton soils (TkB, TkC, TkE).			
		Bresser: See description of Bresser soils (BmB, BmC, BmD, BmE, BrC2).			
		Blakeland: See description of Blakeland loamy sand (Be).			

See footnotes at end of table.

physical and chemical properties of significant layers—Continued

Classification—Con.		Percentage passing sieve—			Permeability	Water-holding capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
Unified [1]	AASHO [2]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
					Inches per hour	*Inches per inch of soil*	*pH*			
CH	A-7	100	100	90 to 98	<0.05	0.2	7.4 to 9.5	Severe	High	High.
CH	A-7	100	100	90 to 98	<0.05	0.2	7.8 to 9.5	Severe	High	High.
ML-CL or ML.	A-4	100	100	50 to 70	2.5 to 5.0	0.15	7.4 to 8.4	Slight	Low	Low.
SM or SC	A-2	100	100	10 to 25	2.5 to 5.0	0.15	7.0 to 8.0	Slight	Low	Low.
SP	A-3	100	80 to 85	15 to 20	5.0 to 10.0	0.08	6.5 to 7.5	Slight	Low	Low.
SC or SM	A-2	100	100	10 to 25	2.5 to 5.0	0.1	6.6 to 7.3	Slight	Low	Low.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Mapping unit	Description	Hydrologic group	Depth from surface (typical profile)	Classification
					USDA texture
				Inches	
UaC UaD UaD3	Ulm loam, 1 to 5 percent slopes. Ulm loam, 5 to 12 percent slopes. Ulm loam, 5 to 12 percent slopes, severely eroded.	3 to 7 inches of loam, underlain by heavy clay loam that extends to a depth of 72 inches.	C	3 to 72	Clay loam
UbD UbE3	Ulm-Beckton complex, 3 to 9 percent slopes. Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded.	Ulm: See description of Ulm soils (UaC, UaD, UaD3). Beckton: 3 to 6 inches of fine sandy loam, over 14 to 24 inches of clay, over clay loam that extends to a depth of 60 inches.	D	4 to 20 20 to 60	Clay Clay loam
VbC VbE	Vebar loamy fine sand, 3 to 5 percent slopes. Vebar loamy fine sand, 5 to 20 percent slopes.	5 feet or more of loamy fine sand, normally free of lime.	A	0 to 60+	Loamy fine sand
WaA WaB WaC	Weld loam, 0 to 1 percent slopes. Weld loam, 1 to 3 percent slopes. Weld loam, 3 to 5 percent slopes.	3 to 7 inches of loam, underlain by strongly structured silty clay or silty clay loam, 12 to 20 inches thick; soil material below 30 to 36 inches is calcareous loess of silt loam texture.	C	7 to 36 36+	Silty clay loam or silty clay. Silt loam
Wb	Wet alluvial land.	All properties variable.			
WcC WcE	Wiley and Colby soils, 3 to 5 percent slopes. Wiley and Colby soils, 5 to 18 percent slopes.	Wiley: 2 to 4 inches of loam, over light clay loam or heavy loam that extends to a depth of 60 inches; strongly calcareous. Colby: Silt loam to a depth of 26 inches or more.	B B	3 to 60 0 to 26	Clay loam and loam Silt loam
Yg	Yoder gravelly sandy loam.	3 or 4 inches of gravelly sandy loam or loamy sand, over 8 or 9 inches of gravelly light clay loam, underlain by clean sand and gravel.	B	3 to 12 12+	Gravelly light clay loam. Sand and gravel
Yt	Yoder-Truckton-Lismas complex.	Yoder: See description of Yoder gravelly sandy loam (Yg). Truckton: See description of Truckton soils (TkB, TkC, TkE). Lismas: See description of Lismas soils (Lc, Lc2).			

[1] For an explanation of the Unified system, see "Unified Soil Classification System," Tech. Memo. No. 3-357, v. 1, Waterways Expt. Sta., Corps of Engineers, March 1953, rev. 1957.

tions of poor surface drainage and poor internal drainage.

The shrink-swell potential (see table 5) is an indication of the volume change to be expected when the moisture content of the soil material changes. In general, clayey soils have high shrink-swell potential, and clean, structureless sands and other nonplastic soil materials have low shrink-swell potential.

Engineering classification systems

Two systems of classifying soils for engineering purposes are in general use: the Unified system, which was developed by the Corps of Engineers, U.S. Army, and the system developed by the American Association of State Highway Officials (AASHO). Estimated classifications of the soils of this survey area, according to both systems, are given in table 5.

Unified system.—This system is based on the identification of soils according to texture, plasticity, and liquid limit. In this system, soil materials are identified as coarse grained, fine grained, and highly organic, and symbols are used to identify each group. For example, SW and SP identify clean sands. The symbols SM and SC identify soils that consist primarily of sand but include some plastic or nonplastic fines. If the major coarse fraction is gravel instead of sand, the symbols GM and GC are used. Soils that consist primarily of fine-grained material, either plastic or nonplastic, are

physical and chemical properties of significant layers—Continued

Classification—Con.		Percentage passing sieve—			Permeability	Water-holding capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
Unified [1]	AASHO [2]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*Inches per hour*	*Inches per inch of soil*	*pH*			
CL	A-6 or A-7	100	100	90 to 95	0.2 to 0.8	0.2	6.6 to 8.4	Slight	Low	Moderate.
CH	A-7	100	100	80 to 90	0.2 to 0.5	0.25	8.0 to 9.0	Severe	High	High.
CL	A-6 and A-7.	100	100	70 to 90	0.5 to 2.5	0.15 to 0.25	7.4 to 8.4	Severe	High	Moderate.
SM	A-2	100	80 to 85	15 to 20	5.0 to 10.0	0.08	6.6 to 7.8	Slight	Low	Low.
CL	A-7	100	100	90 to 98	0.8 to 2.5	0.2	7.4 to 8.4	Slight	Moderate	Moderate.
ML-CL	A-4 or A-6.	100	100	90 to 98	0.8 to 2.5	0.2	7.4 to 8.4	Slight	Moderate to high.	Moderate.
CL or ML	A-4 or A-6.	100	100	90 to 98	0.8 to 2.5	0.2	7.4 to 9.0	Slight to moderate.	Low	Low to moderate.
ML-CL	A-4	100	100	90 to 95	0.8 to 2.5	0.2	7.0 to 8.4	Slight	Moderate to high.	Moderate.
GC or SC	A-2	40 to 60	30 to 40	10 to 25	0.8 to 2.5	0.2	6.1 to 7.3	None	Low	Low.
GP-GM	A-1	30 to 50	20 to 30	5 to 10	5.0 to 10.0	<0.08	6.6 to 7.4	None	Low	Low.

[2] For an explanation of the AASHO system, see AASHO Designation: M 145-49, "The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes" in "Standard Specifications for Highway Materials and Methods of Sampling and Testing," pt. 1, Ed. 8 (1961), published by AASHO.

indicated by the symbols ML and CL if the liquid limit is low and by MH and CH if the liquid limit is high. For soils that are on the borderline between two classifications, a joint symbol is used, for example ML-CL.

AASHO system.—Most highway engineers classify soil materials in accordance with this system, which is based on the bearing strength of the soils. The soils are classified in seven basic groups, ranging from A-1 (gravelly soils of high bearing capacity, the best soils for road subgrade) to A-7 (clayey soils having low strength when wet, the poorest soils for road subgrade). The A-1 group is subdivided into A-1-a and A-1-b. At least 50 percent of the particles making up the soils classified as A-1-a are larger than 2.0 millimeters, and not more than 15 percent are fines (particles smaller than 0.074 millimeter). The A-1-b soils are as much as 25 percent fines. The A-2 soils are as much as 35 percent fines, but the A-3 soils are not more than 10 percent fines. Soils of the A-4, A-5, A-6, and A-7 groups are 36 percent or more fines.

Within each group, the relative engineering value of the soils is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. Soils can be classified by group index only if the grain-size distribution, the liquid limit, and the plasticity index have been determined by laboratory analysis.

TABLE 6.—*Interpretations of soil*

Soil series and map symbols	Suitability as source of—				Degree of limitations affecting use as—			
					Sewage disposal areas			
	Topsoil	Sand	Gravel	Road fill	Filter field	Sewage lagoon	Seepage pit	Homesites
Arvada (AaA, AcB2).	Unsuitable.	Unsuitable	Unsuitable	Poor	Very severe	Moderate	Moderate to severe.	Severe
Ascalon (AnB, AnC, AnD, AnE, ApB2, ApC2).	Fair to good.	Poor	Unsuitable	Good	Slight	Moderate	Slight	Slight
Baca (BaC, BaE, BcE2).	Good	Unsuitable	Unsuitable	Fair	Moderate	Moderate	Moderate to slight.	Slight
Badlands (Bd).	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Blakeland (Be).	Poor	Fair to good.	Poor	Good	Slight	Severe	Slight	Slight
Breaks-Alluvial land complex (Bk):								
Breaks	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Alluvial land	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Bresser (BmB, BmC, BmD, BmE, BrC2).	Fair to good.	Poor	Unsuitable	Good	Slight	Moderate to severe.	Slight	Slight
Bresser-Truckton-Blakeland complex (BtD):								
Bresser soils	Fair to good.	Poor	Unsuitable	Good	Slight	Moderate to severe.	Slight	Slight
Truckton soils	Fair	Poor	Unsuitable	Good	Slight	Severe	Slight	Slight
Blakeland	Poor	Fair to good.	Poor	Good	Slight	Severe	Slight	Slight
Christianburg (CbA, CbB3, CbC, ChA).	Unsuitable.	Unsuitable	Unsuitable	Poor	Very severe.	Slight	Very severe.	Moderate
Eastonville (EaA, EaC).	Fair to poor.	Fair to poor.	Fair	Good	Slight	Severe	Slight	Slight in high areas.
Fort Collins (FcA).	Fair	Unsuitable	Unsuitable	Poor	Slight	Moderate	Slight	Slight to moderate.
Gravelly land (Gr).	Unsuitable.	Fair	Good	Good	Slight	Severe	Slight	Slight
Kutch (KcC, KcE, KcE3).	Fair	Unsuitable	Unsuitable	Poor	Very severe.	Slight	Very severe.	Moderate
Lismas (Lc, Lc2).	Unsuitable.	Unsuitable	Unsuitable	Unsuitable.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe.
Loamy alluvial land (Lo).	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

See footnotes at end of table.

properties that affect engineering

Soil features affecting—					
Highway location	Terraces and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Drainage	Irrigation
Poor bearing capacity; poor drainage.	Very slow permeability; poor stability.	Very slow permeability; slow seepage.	Erodibility; poor stability.	Poor surface drainage; very slow permeability.	Slow intake rate; high salt content.
Good bearing capacity; good drainage; good stability.	Good stability; rapid seepage; susceptibility to wind erosion.	Rapid seepage below a depth of 18 inches.	Moderate permeability.	Good internal drainage.	Good intake rate; moderate to low water-holding capacity below a depth of 18 inches.
Good bearing capacity; good drainage.	Moderately slow permeability.	Slow seepage	Fair stability	Good surface drainage; moderate permeability.	Good intake rate; good water-holding capacity.
(1)	(1)	(1)	(1)	(1)	(1).
Good bearing capacity; good drainage.	Rapid permeability; rapid seepage; erodibility.	Unsuitable	Unsuitable	Good or excessive drainage.	Rapid permeability; low water-holding capacity.
(2)	(2)	(2)	(2)	(2)	(2).
(1)	(1)	(1)	(1)	(1)	(1).
Good bearing capacity; good drainage; good stability.	Good stability; susceptibility to wind erosion.	Rapid seepage below a depth of 18 inches.	Moderate permeability.	Good internal drainage.	Good intake rate; moderate to low water-holding capacity below a depth of 18 inches.
Good bearing capacity; good drainage; good stability.	Good stability; susceptibility to wind erosion.	Rapid seepage below a depth of 18 inches.	Moderate permeability.	Good internal drainage.	Good intake rate; moderate to low water-holding capacity below a depth of 18 inches.
Good bearing capacity; good stability.	Susceptibility to wind and water erosion.	Rapid seepage below a depth of 18 inches.	Erodibility; fair stability.	Good drainage	Rapid intake rate; moderate to low water-holding capacity.
Good bearing capacity; good drainage; no effective water table.	Rapid permeability; rapid seepage; erodibility.	Unsuitable	Unsuitable	Good or excessive drainage.	Rapid permeability; low water-holding capacity.
Poor bearing capacity; poor stability.	Very slow permeability; cracks when dry.	Slow seepage; high salt content.	Poor stability	Good surface drainage; very slow internal drainage.	Very slow permeability; high salt content.
Good bearing capacity; good drainage.	Erodibility; rapid seepage.	Rapid seepage	Susceptibility to sloughing.	Good or excessive drainage.	Rapid permeability; low water-holding capacity.
Fair compaction; fair stability.	Fair stability	Medium seepage; sand strata in places.	Fair stability	Fair internal drainage.	Moderate intake rate; high water-holding capacity.
Good bearing capacity; good stability.	Gravelly soil material.	Very rapid seepage	Gravelly, porous soil material.	Good or excessive drainage.	Unsuitable.
Fair to poor bearing capacity; poor stability.	Very slow permeability; cracks when dry.	Slow seepage	Poor stability	Good surface drainage; very slow internal drainage.	Very slow permeability; strong slopes in most places.
Unsuitable	Unsuitable	Unsuitable; shale at or near the surface.	Unsuitable	Very slow intake rate; very slow internal drainage.	Unsuitable.
(1)	(1)	(1)	(1)	(1)	(1).

TABLE 6.—*Interpretations of soil*

Soil series and map symbols	Suitability as source of—				Degree of limitations affecting use as—			
					Sewage disposal areas			
	Topsoil	Sand	Gravel	Road fill	Filter field	Sewage lagoon	Seepage pit	Homesites
Midway-Bainville complexes (Mb, Mb2):								
Midway	Poor	Unsuitable.	Unsuitable.	Poor	Severe	Severe	Severe	Severe
Bainville	Poor	Unsuitable.	Unsuitable.	Poor	Moderate	Severe	Moderate	Moderate
Midway-Ulm complexes (Mu, Mu3):								
Midway soils	Poor	Unsuitable.	Unsuitable.	Poor	Severe	Severe	Severe	
Ulm soils	Good	Unsuitable.	Unsuitable.	Good to fair.	Moderate	Slight	Moderate	Slight to moderate.
Nunn (NmA, NmC3, NnA).	Good	Unsuitable.	Unsuitable.	Fair	Severe	Moderate to slight.	Slight	Moderate
Platner (PmA, PmB, PmC, PmD).	Good	Unsuitable.	Unsuitable.	Fair	Moderate		Slight	Slight
Platner-Ascalon sandy loams (PsB, PsC):								
Platner soils	Good	Unsuitable.	Unsuitable.	Fair	Moderate		Slight	Slight
Ascalon soils	Fair to good.	Poor	Unsuitable.	Good	Slight		Slight	Slight
Renohill (Rc, ReE2).	Poor	Unsuitable.	Unsuitable.	Poor	Severe	Slight	Very severe.	Severe
Riverwash (Rh).	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Rough broken land (Rn).	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Rough gullied land (Ro).	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Sandy alluvial land (Sa).	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Slickspot-Kutch complexes (SkD, SkD3):								
Slickspots	Unsuitable.	Unsuitable	Unsuitable	Poor	Very severe.	Moderate to slight.	Very severe.	Severe
Kutch soils	Fair	Unsuitable	Unsuitable	Poor	Very severe.	Slight	Very severe.	Moderate
Stoneham (SmB, SmC, SnC, SnE, StC2).	Fair	Poor	Unsuitable	Good	Slight to moderate.	Moderate	Slight	Slight
Terry (TaE).	Poor	Fair	Unsuitable	Fair to good.	Moderate	Moderate to severe.	Moderate	Slight

See footnotes at end of table.

properties that affect engineering—Continued

Soil features affecting—					
Highway location	Terraces and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Drainage	Irrigation
Fair bearing capacity; fair stability.	Slow permeability	Shale at a depth of 24 to 30 inches.	Fair stability	Good surface drainage; slow internal drainage.	Unsuitable.
Poor stability and compaction.	Susceptibility to wind and water erosion.	Interbedded siltstone, soft, fine-grained sandstone and sandy shale at a depth of 10 to 22 inches.	Poor stability	Good drainage	Unsuitable.
Fair bearing capacity; fair stability.	Slow permeability	Shale at a depth of 24 to 30 inches.	Fair stability	Good surface drainage; slow internal drainage.	Unsuitable.
Good bearing capacity; good stability.	Slow to moderate permeability; good stability.	Moderately slow seepage.	Good stability	Good drainage	Moderate to slow permeability; steep slopes.
Fair bearing capacity; fair to poor stability.	Slow permeability	Slow seepage	Erodibility; fair to poor stability.	Good surface drainage; slow internal drainage.	Moderately slow intake rate; good water-holding capacity.
Fair bearing capacity; fair stability.	Slow permeability	Moderately slow seepage; rapid seepage below a depth of 48 inches.	Good stability	Good drainage	Moderate intake rate; good water-holding capacity.
Fair bearing capacity; fair stability.	Slow permeability	Moderately slow seepage; rapid seepage below a depth of 48 inches.	Good stability	Good drainage	Moderate intake rate; good water-holding capacity.
Good bearing capacity; good drainage; good stability.	Good stability; rapid seepage; susceptibility to wind erosion.	Rapid seepage below a depth of 18 inches.	Moderate permeability.	Good internal drainage.	Good intake rate; moderate to low water-holding capacity below a depth of 18 inches.
Poor bearing capacity; poor stability.	Very slow permeability; high shrink-swell potential.	Shale at a depth of 18 to 26 inches.	Poor stability	Good drainage	Slow intake rate; high salt content.
(1)	(1)	(1)	(1)	(1)	(1).
(1)	(1)	(1)	(1)	(1)	(1).
(2)	(2)	(2)	(2)	(2)	(2).
(1)	(1)	(1)	(1)	(1)	(1).
Poor bearing capacity.	Very slow permeability; cracks when dry.	Very slow permeability; slow seepage.	Erodibility; poor stability.	Good surface drainage; very slow internal drainage.	Very slow permeability.
Fair to poor bearing capacity; poor stability.	Very slow permeability; cracks when dry.	Slow seepage	Poor stability	Good surface drainage; very slow internal drainage.	Very slow permeability; strong slopes in most places.
Good bearing capacity; good stability.	Susceptibility to wind and water erosion.	Rapid seepage below a depth of 20 to 30 inches.	Erodibility	Good drainage	Rapid intake rate; moderate to low water-holding capacity.
Good bearing capacity.	Susceptibility to wind and water erosion.	Rapid seepage	Erodibility	Good surface drainage; in places sandstone restricts internal drainage.	Rapid intake rate; moderate to low water-holding capacity.

TABLE 6.—*Interpretations of soil*

Soil series and map symbols	Suitability as source of—				Degree of limitations affecting use as—			
					Sewage disposal areas			
	Topsoil	Sand	Gravel	Road fill	Filter field	Sewage lagoon	Seepage pit	Homesites
Terry-Lismas complexes (Tc, Tc3):								
Terry soils	Poor	Fair	Unsuitable	Fair to good.	Moderate	Moderate to severe.	Moderate	Slight
Lismas soils	Unsuitable.	Unsuitable	Unsuitable	Unsuitable.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe
Terry-Vebar-Tullock complex (TeE):								
Terry soils	Poor	Fair	Unsuitable	Fair to good.	Moderate	Moderate to severe.	Moderate	Moderate
Vebar soils	Fair	Poor	Unsuitable	Good	Slight to moderate.	Severe	Moderate	Severe
Tullock soils	Poor	Poor	Unsuitable	Poor	Moderate; soft sandstone below 18 inches.	Severe	Severe	Severe
Truckton (TkB, TkC, TkE).	Fair	Good	Unsuitable	Good	Slight	Moderate to severe.	Slight	Slight
Truckton, Bresser, and Blakeland soils (TrE2):								
Truckton soils	Fair	Good	Good	Good	Slight	Moderate to severe.	Slight	Slight
Bresser soils	Fair to good.	Poor	Unsuitable	Good	Slight	Moderate to severe.	Slight	Slight
Blakeland soils	Poor	Fair to good.	Poor	Good	Slight	Severe	Slight	Slight
Ulm soils (Uac, Uad, UaD3).	Good	Unsuitable	Unsuitable	Poor to fair.	Moderate	Slight	Moderate	Slight to moderate.
Ulm-Beckton complexes (UbD, UbE3):								
Ulm soils	Good	Unsuitable	Unsuitable	Poor to fair.	Moderate	Slight	Moderate	Slight to moderate.
Beckton soils	Unsuitable.	Unsuitable	Unsuitable	Poor	Very severe	Moderate	Very severe	Severe
Vebar (VbC, VbE).	Fair	Poor	Unsuitable	Good	Slight to moderate.	Severe	Moderate	Severe
Weld (WaA, WaB, WaC).	Good	Unsuitable	Unsuitable	Good to fair.	Moderate	Slight	Moderate	Slight
Wet alluvial land (Wb).	[1]	[1]	[1]	[1]	Very severe	Very severe	Very severe	Very severe

See footnotes at end of table.

properties that affect engineering—Continued

Soil features affecting—					
Highway location	Terraces and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Drainage	Irrigation
Good bearing capacity.	Susceptibility to wind erosion and water erosion.	Rapid seepage	Erodibility	Good surface drainage; in places sandstone restricts internal drainage.	Rapid intake rate; moderate to low water-holding capacity.
Unsuitable	Unsuitable	Unsuitable; shale at or near the surface.	Unsuitable	Very slow intake rate; very slow internal drainage.	Unsuitable.
Good bearing capacity.	Susceptibility to wind erosion and water erosion.	Rapid seepage	Erodibility	Good surface drainage; in places sandstone restricts internal drainage.	Rapid intake rate; moderate to low water-holding capacity.
Good bearing capacity; good stability.	Susceptibility to wind erosion.	Rapid seepage	Rapid permeability; poor stability.	Excessive drainage	Unsuitable.
Soft sandstone near surface.	Unsuitable	Unsuitable; sandstone near surface.	Unsuitable	Excessive drainage	Unsuitable.
Good bearing capacity; good stability.	Susceptibility to wind and water erosion.	Rapid seepage below a depth of 18 inches.	Erodibility; fair stability.	Good drainage	Rapid intake rate; moderate to low water-holding capacity.
Good bearing capacity; good stability.	Susceptibility to wind and water erosion.	Rapid seepage below a depth of 18 inches.	Erodibility; fair stability.	Good drainage	Rapid intake rate; moderate to low water-holding capacity.
Good bearing capacity; good drainage; good stability.	Good stability; susceptibility to wind erosion.	Rapid seepage below a depth of 18 inches.	Moderate permeability.	Good internal drainage.	Good intake rate; moderate to low water-holding capacity below a depth of 18 inches.
Good bearing capacity; good drainage; no effective water table.	Rapid permeability; rapid seepage; erodibility.	Unsuitable	Unsuitable	Good or excessive drainage.	Rapid permeability; low water-holding capacity.
Fair bearing capacity; fair stability.	Slow to moderate permeability; good stability.	Moderately slow seepage.	Good stability	Good drainage	Moderate to slow permeability; steep slopes.
Fair bearing capacity; fair stability.	Slow to moderate permeability; good stability.	Moderately slow seepage.	Good stability	Good drainage	Moderate to slow permeability; steep slopes.
Poor bearing capacity; poor drainage.	Very slow permeability; poor stability.	Very slow permeability; slow seepage.	Erodibility; poor stability.	Very slow permeability.	Slow intake rate.
Good bearing capacity; good stability.	Susceptibility to wind erosion.	Rapid seepage	Rapid permeability; poor stability.	Excessive drainage	Unsuitable.
Fair bearing capacity; fair stability.	Susceptibility to wind and water erosion.	Slow seepage	Erodibility	Good drainage	Moderate intake rate; slow permeability.
High water table	(1)	(1)	(1)	(1)	(1).

TABLE 6.—*Interpretations of soil*

Soil series and map symbols	Suitability as source of—				Degree of limitations affecting use as—			
					Sewage disposal areas			
	Topsoil	Sand	Gravel	Road fill	Filter field	Sewage lagoon	Seepage pit	Homesites
Wiley and Colby soils (WcC, WcE):								
Wiley soils	Fair	Unsuitable	Unsuitable	Poor	Moderate	Moderate	Moderate	Moderate
Colby soils	Poor	Unsuitable	Unsuitable	Poor to fair.	Moderate	Severe	Moderate	Moderate
Yoder (Yg).	Unsuitable.	Good	Good	Good	Slight	Severe to moderate.	Slight	Slight
Yoder-Truckton-Lismas complex (Yt):								
Yoder soils	Unsuitable.	Good	Good	Good	Slight	Severe to moderate.	Slight	Slight
Truckton soils	Fair	Poor	Unsuitable	Good	Slight	Moderate to severe.	Slight	Slight
Lismas	Unsuitable.	Unsuitable	Unsuitable	Unsuitable.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe; shale at or near the surface.	Very severe.

[1] Properties variable; on-site examination required.
[2] Too steep to be suitable for engineering uses.

Genesis, Classification, and Morphology of the Soils

This section discusses the formation of soils, the processes of soil formation, the classification of soils, and the morphology of the soils of this survey area.

Factors of Soil Formation

The characteristics of the soil in any particular place are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and vegetation are the active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a soil that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed, and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. The time needed may be much or little, but some time is always required for the development of distinct horizons.

The factors of soil formation are interrelated, and therefore, the effect of any one factor is hard to isolate with certainty. If four of the factors are constant or nearly so, it is possible to evaluate in a general way the effect of the fifth factor. Such an evaluation is necessarily an approximation, however, because the interaction of all of the factors of soil genesis, rather than the simple sum of the factors, determines the nature of the soil.

Parent material

Both the physical and the chemical nature of the parent material affect the soil. Although this is true everywhere, it is particularly important in areas such as Elbert County, where the temperate, semiarid climate and the sparse vegetation are slow to alter the parent material.

Massive or impermeable parent material must be broken down, or weathered, before soil can develop. Parent material that has a high content of quartz, or that is coarse grained, produces sandy or gravelly soils, and material that has a low content of quartz, or that has a high content of fine particles, produces fine-textured soils.

Parent material that is high in alkaline material tends to develop into alkaline soils, and the presence of free calcium or magnesium salts in the parent material retards translocation of clay and development of a B horizon.

properties that affect engineering—Continued

Soil features affecting—					
Highway location	Terraces and diversions	Farm ponds		Drainage	Irrigation
		Reservoir area	Embankment		
Fair to poor compaction; fair to poor stability.	Fair to poor stability; susceptibility to wind erosion.	Moderately slow seepage.	Fair to poor stability.	Good drainage	Moderate intake rate; good water-holding capacity.
Fair to poor compaction; poor stability.	Fair stability; susceptibility to wind erosion.	Moderately slow seepage.	Poor stability	Good drainage	Moderate intake rate; good water-holding capacity.
Good bearing capacity; good stability.	Shallow over gravel	Very rapid seepage below a depth of 15 inches.	Good stability	Good drainage	Shallow over gravel.
Good bearing capacity; good stability.	Shallow over gravel	Very rapid seepage below a depth of 15 inches.	Good stability	Good drainage	Shallow over gravel.
Good bearing capacity; good stability.	Susceptibility to wind and water erosion.	Rapid seepage below a depth of 18 inches.	Erodibility; fair stability.	Good drainage	Rapid intake rate; moderate to low water-holding capacity.
Unsuitable	Unsuitable	Unsuitable; shale at or near the surface.	Unsuitable	Very slow intake rate; very slow internal drainage.	Unsuitable.

In this survey area the Pierre, Fox Hills, Laramie, Dawson, and Ogallala are the massive or impermeable formations from which soil material is derived (fig. 21). The Dawson formation lies mostly outside of the area. All of these formations, except the Dawson, are high in alkaline earths. Soils that formed directly on these formations are thin. Soils that formed in deposits of reworked or redeposited sediments washed or blown from material weathered from these formations range from moderately shallow to deep.

In addition to these massive or impermeable geologic formations, a portion of the area is covered by a mantle of calcareous loess, which is dominantly silt and very fine sand.

The Lismas and Bainville soils developed over the Pierre formation, the Lismas in material weathered from fine-textured shale, and the Bainville in silty material. The soils of both series are shallow and saline; the Lismas soils are more clayey than the Bainville.

The Arvada, Christianburg, Midway, Renohill, and Ulm soils developed principally in material weathered from the Pierre formation. They have texture, color, and salinity inherited from the Pierre formation, but are somewhat modified by depositions of other materials. The Laramie formation is a source of part of the sediments in which the Christianburg and Arvada soils developed and is probably a source of at least part of the sodium in the Arvada soils.

The Tullock soils developed over the Fox Hills formation. They are shallow and have a high content of fine sand. The Vebar soils formed in material weathered from the Fox Hills formation and redeposited by wind, usually close by and in places on the parent formation. These soils contain a high proportion of fine sand.

The Terry soils formed in material weathered from the fine-grained sandstone of the Laramie formation and from the calcareous part of the Fox Hills formation. These soils have a high content of fine sand and contain more lime than the Tullock and Vebar soils.

The Kutch soils formed in material weathered from shale of the Laramie formation, generally reworked locally and redeposited. These soils contain less gypsum than soils formed in material derived from Pierre shale, and they have a higher proportion of sodium in relation to calcium.

The Blakeland, Truckton, Bresser, and Yoder soils are noncalcareous. They formed in redeposited sediments derived from the noncalcareous Dawson formation. The Dawson formation is sandy and arkosic. It is a source of transported material, though it lies mostly outside of the survey area.

The Ascalon, Platner, and Stoneham soils developed over the Ogallala formation or in locally transported material derived from this formation. The Ogallala formation is a massive, but easily weathered, calcareous, gravelly and sandy formation. The Nunn soils developed in mixed alluvium derived mainly from the Ogallala formation. All of these soils have accumulations of

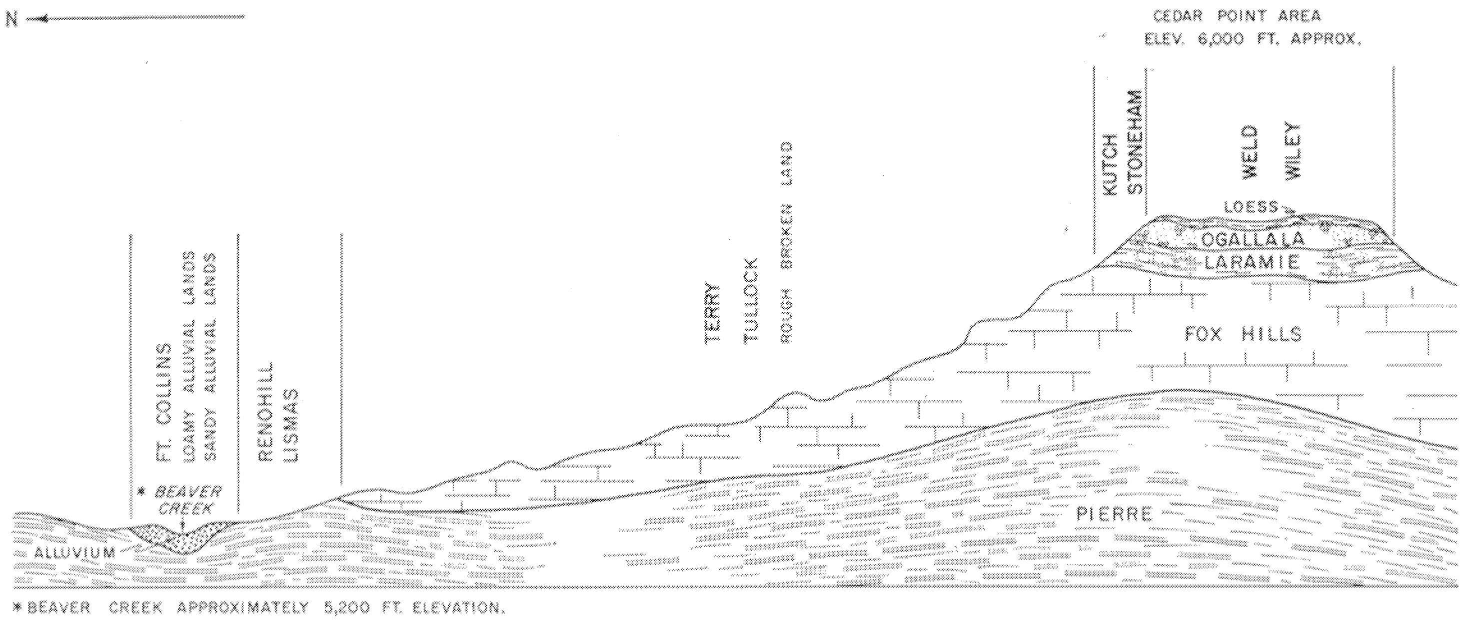

Figure 21.—**North-south cross section from Beaver Creek to Cedar Point, showing relationship of the soils to geologic formations.**

lime, and all of them contain coarse sand and fine gravel.

The Colby, Baca, Weld, and Wiley soils developed in silty loess. All of these soils are silty or loamy, and they retain the lime content of the loess.

Climate

Climate is an important soil-forming factor because it is largely responsible for the weathering of parent material and the growth of vegetation.

The survey area has a temperate, continental climate that is uniform except as modified by topography and aspect. Chestnut soils develop in this kind of climate if other factors of soil formation are not unfavorable. The area is semiarid; it receives only 14 to 17 inches of precipitation annually. Little or none of this moisture ever penetrates the soil below the root zone, and the native vegetation throughout the area is grass. There is little weathering of minerals. Calcium carbonate and soluble salts, although moved downward, are not leached from the root zone.

Plant and animal life

Plant and animal life take up material from the soil and redeposit it in a modified form. Grass is the primary vegetative cover, and micro-organisms, insects, and rodents are the dominant forms of animal life. Although there is some variation in the kinds and abundance of grasses that grow on soils developed over different kinds of parent material, the variations in plant life have not been great enough to significantly alter soil development. For example, grasses are taller and more abundant on soils that formed in permeable parent material. Such soils have a dark-colored surface layer, and their solum is thicker than that of soils that developed over less permeable parent material. The difference in thickness, however, is not great.

Relief

Relief modifies the effects of climate and vegetation, primarily because it governs the amount of moisture that runs off or is absorbed. Concave areas receive runoff, which increases their effective moisture content; convex or steep areas lose moisture by runoff. Flat and concave areas have more strongly developed soils, provided other factors are similar. For example, Weld and Baca soils have stronger expression of horizons than Wiley and Colby soils, which are on steeper slopes.

The direction of the slope is also important. South-facing slopes are warmer, and consequently, evaporation is more rapid than on north-facing slopes.

Time

The development of a soil profile requires a long period of time. Older soils generally show a greater degree of horizonation than younger ones.

In this survey area there is considerable range in the length of time that soil-forming processes have been active. In areas of recently deposited alluvium, soil formation has barely started because the material has been in place too short a time. On some of the flood plains, the material is still accumulating. In the more nearly level uplands, the soil material has been stable for thousands of years, and soil horizonation is distinct. Steep areas are continuously eroding, and the older surface material is being removed and is exposing new underlying material. Consequently, the soils do not have clearly differentiated horizons. The Weld, Platner, Bresser, Baca, and Ascalon soils are among the oldest in the county; Loamy alluvial land and the Lismas and Midway soils are among the youngest.

Processes of Soil Formation

The conditions under which the soils in the eastern part of Elbert County developed are discussed briefly

in this section. Some of the soils are sufficiently developed to have distinct horizons. Other soils are weakly developed and have indistinct horizons. The processes of soil development, reflected in the formation of certain horizons, take one or more of the following forms: accumulation of organic matter, principally in the A horizon; leaching of calcium carbonate from the upper horizons and accumulation in the lower horizons; translocation of silicate clay from the A horizon to the B horizon; accumulation of soluble salts in the profile; and mottling and gleying because of poor drainage.

Accumulation of organic matter.—Organic matter from plants is broken down by micro-organisms to form humus. Normally, the content of organic matter and humus is greatest in the surface layer and decreases with increasing depth. The humus in the soil affects color, consistence, structure, and capacity to hold plant nutrients and moisture. The soils of this survey area formed under a cover of grass, and they are higher in content of organic matter than soils that formed under trees.

Some soils that formed under grass contain little organic matter because vegetation is sparse on sandy or saline soils.

Leaching of calcium carbonate and salts.—In some soils calcium carbonate and salts are leached downward and accumulate in a zone within the profile. Other soils lack calcium carbonate, either because there was none in the parent material or because it has been entirely leached from the profile. A few soils show little or no evidence of downward movement of calcium carbonate, either because erosion has kept pace with leaching or because leaching has been slow on account of strong slopes or slow permeability or both.

In this survey area the soils that have accumulations of lime include those of the Weld, Ascalon, Platner, and Stoneham series. Soils that developed in lime-free parent material include the Bresser, Truckton, Blakeland, and Vebar. Soils that show little evidence of leaching include the Colby, Midway, and Lismas.

Translocation of silicate clay.—Silicate clay moves downward in soils. This movement takes place over a long period of time and eventually causes development of distinct layers, or horizons. Coatings or films of clay on the surface of peds in the B horizon are evidence of translocation of silicate clay. Soils that have prominent clay films include those of the Weld, Bresser, Baca, Platner, Ascalon, and Nunn series. Soils that show only slight evidence of translocation of clay include those of the Fort Collins, Renohill, Stoneham, Truckton, Vebar, and Wiley series. In the Midway, Bainville, Tullock, and Colby soils, no evidence of movement of clay is discernible. In some of the fine-textured soils, such as Christianburg, slickensides are mistaken for clay films and evidence of translocation of clay.

Accumulation of soluble salts.—Salts in solution move upward through the profile by capillary action from saline parent material or from a saline water table. Salts also accumulate in soils as a result of overflow from adjacent, higher lying, saline soils. In dry climates salts accumulate because leaching does not keep pace with capillary action. The Christianburg, Arvada, and Beckton soils have accumulations of salt.

If the proportion of sodium in the soils is high in relation to calcium, the sodium and the fine particles of clay translocate downward and collect in the lower part of the profile. A thin, light-colored, coarser textured crust, low in organic matter and in salts, is left at the surface. The B2 horizon, high in clay and sodium, retards the movement of water. Only salt-tolerant plants can grow on these soils, and slickspots form in those places where salinity is so severe that even those plants cannot survive. The Arvada and Beckton soils and the Slickspot-Kutch complex contain slickspots.

Gleying and mottling.—In poorly drained soils, water replaces air, and reduction of iron forms bluish-gray, gleyed layers in the lower part of the profile. Mottles form in the absence of oxygen. Wet alluvial land is an example of a gleyed, mottled soil.

Classification of the Soils

Soils are placed in narrowly defined classes for the organization and application of knowledge about their behavior within farms and counties. They are placed in broader categories for study and comparison of larger areas.

Table 7 shows the classification of the soil series of this survey area by order and great soil group. It also describes the parent material and some of the significant characteristics of the soils of each series. The three soil orders are the most inclusive categories in the soil classification system. A great soil group is a narrower category, within one of the three orders, and is made up of soils that are similar in internal characteristics.

Zonal order.—Soils in the zonal order have well-expressed, genetically related horizons that reflect the dominant influence of climate and living organisms, chiefly vegetation, in their formation. The zonal soils in this survey area are in the Brown and Chestnut great soil groups.

Brown soils are a group of soils having a brown A horizon of moderate thickness and a lighter colored B or C horizon. Commonly, these soils have an accumulation of lime at a depth of 1 to 3 feet. They formed under short grasses, bunch grasses, and shrubs in a semiarid, temperate to cool-temperate climate.

The Baca, Fort Collins, Renohill, Stoneham, Terry, Ulm, Wiley, and Yoder soils are in the Brown great soil group. All of these soils have a textural B horizon with weak to moderate, medium to coarse, prismatic structure. The most nearly typical Brown soils in this area are the Fort Collins soils.

Chestnut soils are a group of soils that have a dark-brown surface horizon that grades to lighter colored horizons. They have accumulated lime at a depth of 1 to 4 feet. These soils formed under mixed tall and short grasses in a subhumid to semiarid, temperate to cool-temperate climate. In this area Chestnut soils have a darker colored surface layer than Brown soils.

The Ascalon, Bresser, Eastonville, Kutch, Nunn, Platner, Truckton, Vebar, and Weld soils are in the Chestnut great soil group. All of these soils have a textural B horizon that has weak to moderate, medium to coarse, prismatic structure. The most nearly typical Chestnut soils in this area are the Ascalon and Vebar soils.

Intrazonal order.—Soils in the intrazonal order have evident, genetically related horizons that reflect the dominant influence of relief, parent material, or time over the

TABLE 7.—*Classification of soil series by order and great soil group, and selected significant characteristics of each series*

ZONAL ORDER

Great soil group and series	Parent material	Relief and physiographic position	Texture of B horizon, or of C horizon if there is no B	Other significant characteristics
Brown group:				
Baca	Eolian deposits	Gently sloping to moderately steep uplands.	Silty clay loam to clay loam.	Moderately thick solum; uppermost 8 to 10 inches is leached; moderate B2 horizon.
Fort Collins	Mixed alluvium	Nearly level or very gently sloping stream terraces.	Loam and clay loam to silty clay loam.	Stratified deposits; weak textural B2 horizon.
Renohill	Residuum from sedimentary rocks.	Very gently sloping to moderately steep uplands.	Clay loam and silty clay loam to clay.	Moderate textural B2 horizon; depth variable.
Stoneham	Outwash from the Ogallala formation.	Very gently sloping to rolling and moderately steep uplands.	Loam to clay loam	Weak textural B2 horizon; moderately deep over calcareous, gravelly material.
Terry	Residuum from sedimentary rocks.	Rolling to steep uplands	Fine sandy clay loam to heavy loamy fine sand.	Weak textural B2 horizon; less than 30 inches to bedrock.
Ulm	Residuum from sedimentary rocks.	Very gently sloping to moderately steep uplands.	Clay loam	Strong B2 horizon.
Wiley	Eolian deposits of loess	Gently sloping to moderately steep uplands.	Clay loam to very fine sandy loam.	Thin solum; weak B2 horizon; calcareous near surface.
Yoder	Reworked arkosic deposits from the Dawson formation.	Sloping to steep uplands	Gravelly loam to clay loam.	Noncalcareous; very gravelly; shallow over sand and gravel.
Chestnut group:				
Ascalon	Sediments from the Ogallala formation.	Very gently sloping to rolling and moderately steep uplands.	Sandy loam to sandy clay loam.	Moderate textural B2 horizon; noncalcareous to a depth of 20 to 28 inches.
Bresser	Reworked arkose beds from the Dawson formation.	Very gently sloping to rolling and moderately steep uplands.	Sandy clay loam to clay loam.	Noncalcareous to a depth of more than 20 inches in most places; moderate B2 horizons.
Eastonville	Arkose alluvium from Dawson formation.	Nearly level stream terraces.	Sandy loam to heavy sandy loam.	Thick solum; leached to a depth of more than 3 feet.
Kutch	Residuum from shale	Nearly level to moderately steep uplands.	Clay	Weak textural B2 horizon; less than 40 inches to bedrock.
Nunn	Mixed alluvium	Nearly level to gently sloping stream terraces and alluvial fans.	Clay loam or silty clay loam.	More than 60 inches to bedrock; noncalcareous to a depth of 14 to 22 inches.
Platner (intergrade to Planosols).	Tertiary sandy and gravelly sediments from the Ogallala formation.	Nearly level to sloping uplands.	Clay loam or sandy clay loam.	Incipient A2 horizon; sandier than Weld.
Truckton	Arkosic, eolian sand derived from alluvium and outwash from the Dawson formation.	Gently sloping to rolling and steep.	Sandy loam to sandy clay loam.	Noncalcareous to a depth of more than 60 inches; the B horizon is very hard when dry; weak B2 horizon.
Vebar	Reworked valley fill from sandstone and siltstone of the Fox Hills and Laramie formations.	Gently sloping to rolling and steep uplands.	Fine sandy loam to loamy fine sand.	Arkosic sand.
Weld (intergrade to Planosols).	Eolian silty loess	Nearly level to strongly sloping uplands.	Clay loam or silty clay loam to silty clay.	Thin, silty, incipient A2 horizon in places.

TABLE 7.—*Classification of soil series by order and great soil group, and selected significant characteristics of each series*—Continued

INTRAZONAL ORDER

Great soil group and series	Parent material	Relief and physiographic position	Texture of B horizon, or of C horizon if there is no B	Other significant characteristics
Solonetz group:				
Arvada	Alluvium or valley fill from sedimentary rocks.	Nearly level to very gently sloping terraces and alluvial fans.	Clay	Content of sodium is greater than 15 percent.
Beckton	Residuum, local alluvium, or valley fill from sedimentary rocks.	Level to gently sloping terraces.	Clay	Content of sodium is greater than 15 percent.

AZONAL ORDER

Great soil group and series	Parent material	Relief and physiographic position	Texture of B horizon, or of C horizon if there is no B	Other significant characteristics
Alluvial group:				
Christianburg	Alluvium from soils derived from sedimentary rocks.	Nearly level to sloping terraces and alluvial fans.	Clay	Moderate structure; some clay films.
Regosol group:				
Blakeland	Eolian sand and arkosic deposits.	Gently sloping to rolling uplands.	Loamy sand or sand	Dark, noncalcareous A horizon; hard when dry.
Colby	Calcareous loess	Gently sloping to moderately steep uplands.	Silt loam	Calcareous throughout the profile.
Lithosol group:				
Bainville	Sedimentary rocks (sandy shale).	Gently sloping to moderately steep uplands.	Loam	Calcareous; shallow over shale or sandstone.
Lismas	Sedimentary rocks (shale).	Gently sloping to moderately steep uplands.	Clay	Shallow over shale.
Midway	Sedimentary rocks derived from shale and sandstone.	Gently sloping to moderately steep uplands.	Clay loam	Calcareous at a depth greater than 3 inches.
Tullock	Residuum from sedimentary rocks.	Sloping to steep uplands	Loamy fine sand	Surface layer generally noncalcareous; shallow over sandstone or shale.

effects of climate and plant and animal life in their formation. The intrazonal soils in this survey area are in the Solonetz great soil group.

Solonetz soils are a group of soils that have a friable surface horizon of variable thickness, which is underlain by dark, hard soil material ordinarily of columnar structure. Commonly, these soils are highly alkaline. They formed under grass or shrub vegetation, mainly in a subhumid or semiarid climate.

The Arvada and Beckton soils and the Slickspots mapped with the Kutch soils are in the Solonetz great soil group. The Kutch soils are classified in the Chestnut great soil group. The Solonetz soils of this area have a thin A1 horizon, or none. Many bare areas, or Slickspots, have the ash-colored A2 horizon exposed. The textural B horizon is darker colored than the A horizon and is strongly alkaline. Generally, the B horizon has columnar structure, and the peds have bun-shaped tops.

Azonal order.—Soils in the azonal order lack genetically related horizons; most are so young that there has not been time for genetic horizons to form. Lack of horizonation is also caused by resistant parent material and steep topography. The azonal soils in this survey area are in the Regosol, Lithosol, and Alluvial great soil groups.

Regosols are a group of soils lacking definite genetic horizons and forming in deep, unconsolidated or soft, rocky deposits. This great soil group is represented in this area by the Blakeland and Colby soils.

The Blakeland soils have a grayish-brown A1 horizon but show little or no development of a textural B horizon.

Lithosols are a group of soils having no clearly expressed soil horizons and consisting of a freshly or imperfectly weathered mass of rock fragments. These soils occur mainly on steep slopes.

The Bainville, Tullock, Midway, and Lismas soils are classified in the Lithosol great soil group.

The Tullock soils are shallow. They lack structural development and have no textural B horizon. They are light brownish gray to yellowish brown. These soils occupy steep or very steep slopes.

The Bainville soils lack structural development and have no textural B2 horizon. They are shallow, medium textured, and calcareous. These soils occupy gently sloping or sloping areas.

The Lismas soils are shallow, have no textural B horizon, and are calcareous if the underlying shale is calcareous. These soils occur on gently sloping or sloping uplands.

The Midway soils lack true horizon development. They occur on gently sloping to moderately steep uplands.

Alluvial soils are a group of soils that consist of water-transported and relatively recently deposited material, and are characterized by weak modification, or no modification, of the original material by soil-forming processes.

Soils of the Christianburg series, the only representative of this great soil group in this survey area, are not typical Alluvial soils. They have moderate structure in the B horizon and an accumulation of lime in the C horizon.

Morphology of the Soils

In the following pages each series mapped in this survey area is described in alphabetical order. The soil-forming factors of parent material, native vegetation, and relief are given, and a profile that is representative of the series is described in detail. A brief statement describing the range in characteristics of the soils as they occur in this area follows the description of the profile.

ARVADA SERIES

This series consists of deep and moderately deep, light-gray solodized-Solonetz soils. These soils developed in outwash from dark-gray shale and fine-grained sandstone of the lower Dawson, Pierre, Laramie, and Fox Hills formations.

The Arvada soils occupy stream terraces and alluvial fans. The slope range is 0 to 3 percent. An undisturbed profile normally has an A2–B2t–B3sa–C horizon sequence. The native vegetation consists mainly of western wheatgrass, alkali sacaton, and saltgrass. Blue grama grows in some of the gently sloping areas.

The Arvada soils have an A2 horizon, which the Christianburg soils lack. The B2 horizon of the Arvada soils has a stronger structure than that of the Christianburg soils.

Profile of an Arvada soil in an area of native grassland, approximately ¼ mile east of the NW. corner of sec. 2, T. 7 S., R. 59 W.:

A2—0 to 2 inches, light-gray (10YR 7/2) sandy loam; light brownish gray (10YR 6/2) when moist; weak to moderate, thin, platy structure breaking to medium to very fine granular; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B21t—2 to 6 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist; strong or moderate, columnar structure breaking to strong, fine, angular blocky; extremely hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

B22t—6 to 13 inches, light yellowish-brown (2.5Y 6/3) clay, olive brown (2.5Y 4/3) when moist; strong, medium, prismatic structure breaking to strong, medium, angular blocky; extremely hard when dry, very firm when moist; calcareous; pH approximately 9.0; gradual, smooth boundary.

B3sa—13 to 20 inches, light brownish-gray (2.5Y 6/2) light clay, dark grayish brown (2.5Y 4/2) when moist; weak to moderate, medium, subangular blocky structure; extremely hard when dry, firm when moist; strongly calcareous; weak Ca horizon with soluble salts as crystals, small concretions, and thin seams and streaks; pH approximately 9.2; clear, smooth boundary.

C—20 to 40 inches +, light brownish-gray (2.5Y 6/2) heavy clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, friable when moist; strongly calcareous; moderate horizon of soluble salt accumulation with visible salts as concretions, crystals, and thin seams and streaks.

The texture of the surface layer ranges from loam to fine sandy loam or very fine sandy loam, and the thickness of that horizon ranges from 1 to 4 inches. The color ranges from light gray to light brownish gray when the soil is dry, and from light brownish gray to grayish brown when the soil is moist.

The texture of the B2t horizon ranges from clay to heavy clay loam. Thickness of this horizon ranges from 10 to 14 inches. The color ranges from grayish brown to light yellowish brown. Thickness of the solum ranges from 30 to 46 inches.

ASCALON SERIES

This series consists of deep and moderately deep, moderately sandy Chestnut soils of the High Plains. These soils developed in calcareous Tertiary outwash and wind-reworked material modified in places by eolian silt and sandy arkosic material. The Ascalon soils mapped in this survey area are fairly representative of the modal soils of the series, but they are generally in the minimal range.

The slope range is 1 to 15 percent. In an undisturbed profile, the horizon sequence is normally A1–B2t–B3–Cca–C. The native vegetation consists of grasses, such as sandreed, little bluestem, and needlegrass.

The Ascalon soils are sandier than the associated Platner soils, and they have a weaker B2 horizon than those soils. They are similar to the Bresser soils, but they developed in calcareous material and, unlike those soils, the Ascalon soils have a Cca horizon.

Profile of Ascalon sandy loam in a cultivated field, 450 feet south of the NW. corner of sec. 7, T. 13 S., R. 58 W.:

Ap—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine granular; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B1—4 to 7 inches, brown (10YR 5/3) heavy sandy loam or light sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films on faces of peds; noncalcareous; clear, smooth boundary.

B21t—7 to 12 inches, brown (10YR 5/3) sandy clay loam, brown or dark brown (7.5YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium and fine, subangular blocky; hard when dry, friable when moist; thin, nearly continu-

ous clay films on faces of peds; noncalcareous; clear, smooth boundary.

B22t—12 to 19 inches, brown (7.5YR 5/2) sandy clay loam, brown or dark brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure breaking to strong, medium and fine, subangular blocky; very hard when dry, firm when moist; thin, continuous clay films on surfaces of peds; noncalcareous; smooth, gradual boundary.

B3—19 to 24 inches, pale-brown (10YR 6/3) heavy sandy loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; thin, patchy clay films on faces of peds; noncalcareous; smooth, diffuse boundary.

C1—24 to 34 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; massive; hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

Cca—34 to 46 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, very friable when moist; very strongly calcareous with calcium carbonate both as concretions and in finely divided forms.

In places the color of the moist surface layer is as light as 10YR 4/2. Also, in the southern part of the area the B horizon is less well developed than in a representative profile, the solum is thinner, and in many places the sand fraction is coarser. In some places the parent material has been altered by the addition of loess to the extent that the underlying material is loamy or silty and contains much lime and fine gravel.

BACA SERIES

This series consists of moderately deep or shallow Brown soils that developed in light-colored, calcareous, medium-textured and moderately fine textured deposits of loess. Most areas of these soils are on uplands in the northern part of the survey area. Small, isolated tracts occur in the central and southern parts. The slope range is 3 to 15 percent. The native vegetation consists of short grasses, chiefly blue grama.

The Baca soils resemble the Wiley and Weld soils. They have a more strongly developed B horizon than the Wiley soils. They are lighter in color than the Weld soils, and their subsoil contains less clay than that of the Weld soils.

Profile of Baca loam in an area of native grassland, approximately 1,000 feet south and 300 feet west of the NE. corner of the NW¼ of sec. 28, T. 7 S., R. 58 W.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; weakly calcareous, clear, smooth boundary.

A3—2 to 5 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; slightly hard when dry, very friable when moist; thin, patchy clay films on some of the soil aggregates; weakly calcareous; gradual, smooth boundary.

B2t—5 to 15 inches, light yellowish-brown (2.5Y 6/3) silty clay loam, olive brown (2.5Y 4/3) when moist; moderate, fine, prismatic structure breaking to moderate to strong, fine, angular and subangular blocky; hard when dry, friable when moist; many patchy clay films on both horizontal and vertical faces of soil aggregates; few, small, calcium carbonate concretions irregularly distributed in this horizon; calcareous; diffuse, smooth boundary.

B3ca—15 to 23 inches, light yellowish-brown (2.5Y 6/3) light silty clay loam, light olive brown (2.5Y 5/3) when moist; weak, medium, prismatic structure breaking to weak, medium, angular and subangular blocky; hard when dry, friable when moist; few, patchy clay films, mostly on horizontal faces of soil aggregates; weak Ca horizon with visible calcium carbonate occurring as concretions and in thin seams and streaks; calcareous; gradual, smooth boundary.

Cca—23 to 36 inches, light yellowish-brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) when moist; massive; hard when dry, friable when moist; calcareous; weak to moderate Ca horizon with some visible calcium carbonate as concretions, in thin seams and streaks, and in finely divided forms.

C—36 to 60 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, very friable when moist; calcareous; some accumulated calcium carbonate, but less than in Cca horizon.

The Baca soils range from weakly calcareous to very strongly calcareous below a depth of 4 inches. The texture of the A horizon ranges from loam to coarse silt loam. The thickness of this horizon ranges from 2 to 5 inches. The texture of the B2 horizon ranges from silty clay loam to clay loam. The thickness of that horizon ranges from 5 to 10 inches. The thickness of the solum ranges from 10 inches in moderately steep areas to 25 inches in gently sloping areas.

BAINVILLE SERIES

The Bainville series consists of shallow, loamy Lithosols that developed in calcareous silty shale, fine-grained sandstone, and siltstone. In many places, siltstone and sandstone are exposed.

These soils normally occupy upland slopes and ridges. The slope range is 3 to 15 percent. The horizon sequence is normally A–AC–C. The native vegetation includes blue grama, western wheatgrass, sideoats grama, little bluestem, and three-awn. Little bluestem, western wheatgrass, and sideoats grama grow better in the more gently sloping areas than in places where the slopes are stronger.

The Bainville soils are associated with the Renohill and Midway soils. The Renohill soils have a developed B horizon, which the Bainville soils lack. The Midway soils are more clayey than the Bainville soils and less uniform in color.

Profile of Bainville loam in an area of grassland, approximately 1,000 feet south and 200 feet east of the NW. corner of sec. 33, T. 8 S., R. 57 W.:

A1—0 to 3 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate to strong, very fine, granular structure or crumb structure; soft when dry, very friable when moist; strongly calcareous; clear, smooth boundary.

AC—3 to 6 inches, light olive-brown (2.5Y 5/3) loam, olive brown (2.5Y 4/3) when moist; weak, coarse, prismatic structure breaking to weak to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; very strongly calcareous; clear, smooth boundary.

C—6 to 14 inches, light yellowish-brown (2.5Y 6/3) loam or very fine sandy loam, light olive brown (25Y 5/4) when moist; very weak, coarse, prismatic structure breaking to weak to medium, subangular blocky; slightly hard when dry, friable when moist; strongly calcareous; diffuse, wavy boundary.

R—14 to 20 inches, light yellowish-brown (2.5Y 6/3) interbedded siltstone, soft, fine-grained sandstone, and sandy shale; light olive brown (2.5Y 5/4) when moist; strongly calcareous.

The texture of the A horizon ranges from very fine sandy loam to light clay loam. The thickness of that horizon ranges from 2 to 4 inches. The texture of the C

horizon ranges from loam to very fine sandy loam. The thickness of the solum ranges from 10 to 22 inches.

BECKTON SERIES

The Beckton series consists of fine textured and moderately fine textured solodized-Solonetz soils that developed in residuum, local alluvium, or valley fill weathered from sedimentary rocks.

These soils occupy stream terraces. Normally, they have a dark-colored A1 horizon, but in many places the A2 horizon is at the surface. The slope range is 0 to 9 percent. The native vegetation consists of blue grama, western wheatgrass, alkali sacaton, and pear cactus.

The Beckton soils resemble the Arvada soils, but the A1 horizon of the Beckton soils is darker colored than that of the Arvada soils, and the upper part of the B2 horizon lacks the high conductivity, high pH, and high exchangeable sodium content that is typical of that part of the profile of the Arvada soils.

Profile of a Beckton soil in an area of native grassland, approximately 1,800 feet west and 1,150 feet south of the NE. corner of sec. 19, T. 9 S., R. 59 W.:

A2—0 to 3 inches, white (10YR 8/1) fine sandy loam, gray (10YR 5/1) when moist; single grain; loose when dry, very friable when moist; noncalcareous; clear, abrupt boundary.

B21t—3 to 6 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate to strong, coarse, prismatic structure breaking to strong, angular blocky; extremely hard when dry, extremely firm when moist; thick, continuous clay films; noncalcareous; pH approximately 7.8; clear, smooth boundary.

B22t—6 to 10 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist; moderate, coarse, prismatic structure breaking to strong, angular blocky; extremely hard when dry, extremely firm when moist; thick, continuous clay films; noncalcareous; pH approximately 8.9; clear, smooth boundary.

B3—10 to 15 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure breaking to moderate, medium, angular blocky; extremely hard when dry, extremely firm when moist; thick, continuous clay films; noncalcareous; pH approximately 9.0; clear, smooth boundary.

B3ca—15 to 18 inches, light grayish-brown (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure breaking to moderate, medium, angular blocky; very hard when dry, very firm when moist; continuous clay films; calcareous; clear, gradual boundary.

Cca—18 to 60 inches, light grayish-brown (2.5Y 6/2) clay loam, olive brown (2.5Y 4/3) when moist; massive; very hard when dry, very firm when moist; calcareous; visible lime occurs as concretions and in streaks.

The A1 horizon, if present, ranges in texture from fine sandy loam to loam, and the color of that horizon ranges from gray to very dark gray. The texture of the A2 horizon ranges from fine sandy loam to loam, and the color ranges from white to light gray when the soil is dry and from light brownish gray to grayish brown when the soil is moist. The thickness of the A2 horizon ranges from 3 to 6 inches. The B2t horizon ranges from 14 to 24 inches in thickness. The color of that horizon ranges from light grayish brown to grayish brown when the soil is dry and from dark grayish brown to very dark grayish brown when the soil is moist.

BLAKELAND SERIES

The Blakeland series consists of well-drained Regosols that developed in thick deposits of eolian sand or wind-reworked sandy alluvium weathered from the Dawson formation. Although sandy, the layers just below the surface layer are hard when dry and offer considerable resistance to digging tools.

The slope range is 3 to 15 percent. The native vegetation consists of such grasses as big bluestem, sand bluestem, and sandreed.

The Blakeland soils have a coarser texture throughout than the Truckton soils, and they do not have a B horizon. They are much deeper than the Yoder soils and less gravelly.

Profile of Blakeland loamy sand in an area of native grassland, approximately 500 feet west and 25 feet south of the NE. corner of the NW¼ of sec. 26, T. 9 S., R. 57 W.:

A11—0 to 5 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, very fine, granular structure or single grain; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A12—5 to 11 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; very weak, coarse, subangular blocky structure breaking to single grain; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A13—11 to 13 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; very weak, coarse, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C1—13 to 24 inches, brown (10YR 5/3) loamy sand, brown or dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C2—24 to 60 inches, brown (10YR 5/3) loamy sand or sand, brown or dark brown (10YR 4/3) when moist; massive; hard when dry, very friable when moist; noncalcareous.

The texture of the A horizon ranges from loamy sand to loamy fine sand. The thickness of that horizon ranges from 8 to 14 inches.

BRESSER SERIES

The Bresser series consists of deep and moderately deep, somewhat sandy Chestnut soils of the uplands. These soils developed in sandy outwash or wind-reworked material from the Dawson formation. They are typically noncalcareous, but they are slightly calcareous in some places.

The slope range is 1 to 15 percent. The native vegetation is predominantly sand bluestem, sandreed, and big bluestem. There are some mid grasses, such as little bluestem, and some short grasses, such as blue grama.

These soils are similar to the Ascalon soils, but they are generally noncalcareous. They are also similar to the Truckton soils, but their subsoil is finer textured than that of the Truckton soils and has stronger structure.

Profile of Bresser sandy loam in an area of native grassland, about 1,200 feet east and 300 feet south of the NW. corner of sec. 29, T. 12 S., R. 59 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—3 to 8 inches, grayish-brown (10YR 5/2) light sandy clay loam; dark brown (10YR 3/3) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular; hard when dry, very friable when moist; thin, patchy clay films on both horizontal and vertical faces of most peds; noncalcareous; clear, smooth boundary.

B21t—8 to 14 inches, brown or dark-brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, subangular blocky; very hard when dry, friable when moist; thin, continuous clay films on the surfaces of the peds; noncalcareous; clear, smooth boundary.

B22t—14 to 21 inches, brown (10 YR 5/3) sandy clay loam, brown or dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, subangular blocky; very hard when dry, firm when moist; thin, patchy clay films on both horizontal and vertical faces of the peds; noncalcareous; clear, smooth boundary.

B3—21 to 29 inches, pale-brown (10YR 6/3) light sandy clay loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; common, thin, patchy clay films on both horizontal and vertical faces of peds; noncalcareous; gradual, smooth boundary.

C—29 to 40 inches, light yellowish-brown (2.5Y 6/3) light sandy clay loam or heavy sandy loam, light olive brown (2.5Y 5/3) when moist; massive; very hard when dry, friable when moist; noncalcareous or, in spots, very weakly calcareous.

The texture of the A horizon is sandy loam or heavy sandy loam. The thickness of that horizon ranges from 3 to 8 inches. The color ranges from grayish brown to dark grayish brown when the soil is dry. In a few small areas, the surface layer is lighter colored.

The texture of the B2 horizon ranges from clay loam to heavy sandy loam. The thickness of that horizon ranges from 6 to 16 inches. The color ranges from light yellowish brown to dark grayish brown when the soil is dry and from light olive brown to very dark grayish brown when the soil is moist.

The thickness of the solum ranges from 12 inches in moderately steep areas to 36 inches in very gently sloping areas. The texture becomes coarser as the slope gradient increases.

CHRISTIANBURG SERIES

This series consists of fine-textured Alluvial soils. The soils developed in uniform or weakly stratified alluvium washed from soils derived from fine sandy shale, sandstone, and silty shale of the lower Dawson and Laramie formations.

The Christianburg soils occupy terraces and alluvial fans. If the soils have not been disturbed, they normally have an A–B–Cca–C horizon sequence. The slope range is 0 to 5 percent. The native vegetation consists of western wheatgrass, alkali sacaton, and saltgrass in the nearly level areas. On the stronger slopes, the vegetation includes blue grama.

The Christianburg soils differ from the Arvada soils in lacking an A2 horizon and having weaker structure in the B2 horizon.

Profile of a Christianburg soil in an area of native grassland, near the NW. corner of the SW¼ of sec. 14, T. 10 S., R. 59 W.:

A1—0 to 4 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B2—4 to 13 inches, very dark grayish-brown (2.5Y 3/2) clay, black (2.5Y 2/2) when moist; moderate, medium, angular and subangular blocky structure; very hard when dry, firm when moist; medium, patchy clay films on both horizontal and vertical faces of the soil aggregates; noncalcareous; gradual, smooth boundary.

Cca1—13 to 19 inches, dark grayish-brown to olive-brown (2.5Y 4/3) clay, very dark grayish brown to olive brown (2.5Y 3/3) when moist; massive; extremely hard when dry, very firm when moist; calcareous; a few calcium carbonate concretions and a few mycelial streaks of lime; gradual, smooth boundary.

Cca2—19 to 24 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) when moist; massive; extremely hard when dry, very firm when moist; strongly calcareous; common, coarse, prominent, dark reddish-brown (5YR 3/3) mottles; moderate lime accumulation with visible lime occurring principally as soft nodules and in mycelial streaks and stains; a few crystals of gypsum.

IIc—24 inches +, alternating layers of medium-textured and coarse-textured alluvium.

The texture of the A horizon ranges from clay to silty clay loam. The thickness of that horizon ranges from 2 to 7 inches. The color of the A horizon ranges from light brownish gray to dark grayish brown when the soil is dry and from dark grayish brown to very dark grayish brown when the soil is moist. In some areas the surface layer is sandy loam because sandy material washed from adjacent slopes has been deposited on the surface.

Generally, there is a structural B horizon that has stronger prismatic or blocky structure than the underlying C horizon. This horizon is not present in all places.

In some places the parent material is stratified with coarser textured material or with clay.

COLBY SERIES

The Colby series consists of shallow, light-colored, calcareous, silty Regosols that developed in loess.

These soils generally occur in the uplands, in areas where precipitation is less than 20 inches annually. If undisturbed, they commonly have an A1–AC–Cca–C horizon sequence. The slopes are convex, and the range in gradient is 3 to 18 percent. The native vegetation consists of short grasses, mainly blue grama. Sideoats grama and little bluestem grow in areas where moisture conditions are more favorable.

The Colby soils are not so fine textured as the Baca and Wiley soils.

Profile of Colby silt loam in an area of native grassland, approximately 150 feet south and 20 feet east of the NW. corner of the SW¼ of sec. 2, T. 8 S., R 57 W.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; loose when dry, very friable when moist; calcareous; clear, smooth boundary.

A12—2 to 5 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak medium, subangular blocky structure; soft when dry, very friable when moist; calcareous; clear, smooth boundary.

Cca—5 to 18 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist; very strongly calcareous; visible, weak concretions of lime; gradual, smooth boundary.

C1—18 to 26 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; very weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist; strongly calcareous; clear, smooth boundary.

C2—26 inches +, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist; strongly calcareous.

The texture of the A horizon ranges from silt loam to very fine sandy loam. The thickness of that horizon ranges from 2 to 6 inches. The thickness of the solum ranges from 4 to 8 inches. The colors in the solum range from light brownish gray to brown.

EASTONVILLE SERIES

The Eastonville series consists of moderately deep, noncalcareous, sandy Brunizems that are moderately dark colored. The soils developed in arkosic alluvium washed from soils that formed in material derived from the Dawson formation.

These soils occupy stream terraces. The slope range is 0 to 5 percent. Level and nearly level areas are flooded occasionally. Tall and short grasses, such as sand bluestem, sandreed, big bluestem, and blue grama, grow on these soils.

The Eastonville soils have a darker colored surface layer than the Blakeland soils. Also, they have a textural B horizon, which the Blakeland soils lack. The Eastonville soils are darker colored than the Truckton soils, and they have less clay in their subsoil.

Profile of Eastonville loamy sand in an area of native grassland, approximately 500 feet south and 20 feet east of the NW. corner of sec. 23, T. 11 S., R. 57 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) when moist; weak, fine, crumb structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—3 to 10 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to weak to moderate, fine crumb; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A3—10 to 17 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; weak, coarse, subangular blocky structure; very hard when dry, very friable when moist; noncalcareous; pH approximately 7.5; gradual, smooth boundary.

B21t—17 to 26 inches, brown (10YR 5/3) light sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry, very friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; noncalcareous; pH approximately 7.5; gradual, smooth boundary.

B22t—26 to 34 inches, grayish-brown (10YR 5/2) gravelly light sandy loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, medium, subangular blocky structure; extremely hard when dry, very friable when moist; many thin, patchy clay films on both horizontal and vertical faces of peds; approximately 30 per cent of this horizon is gravel; noncalcareous; abrupt, smooth boundary.

B2tb—34 to 45 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, angular and subangular blocky structure; extremely hard when dry, friable when moist; thin, nearly continuous clay films on surfaces of peds; noncalcareous; gradual, wavy boundary.

C—45 to 60 inches +, light brownish-gray (10YR 6/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) when moist; single grain; loose when either dry or moist; approximately 40 percent gravel; strongly calcareous.

The texture of the A horizon ranges from sandy loam to loamy sand. The thickness of that horizon ranges from 7 to 17 inches.

The B2t horizon ranges in texture from sandy loam to heavy loamy sand. The thickness of that horizon ranges from 10 to 18 inches. The B2tb horizon is discontinuous.

FORT COLLINS SERIES

This series consists of moderately deep Brown soils that are light brownish gray and medium textured or moderately fine textured. These soils developed in mixed alluvium derived from loess and from fine-grained sandstone of the Fox Hills and Laramie formations. The Fort Collins soils mapped in this survey area have weaker horizonation than the modal soils of the series.

These soils occupy stream terraces. The slope range is 0 to 3 percent. The native vegetation consists mainly of short grasses mixed with western wheatgrass, blue grama, buffalograss, and needlegrass.

The Fort Collins soils have a lighter colored surface layer and subsoil than the Nunn soils. Also, their subsoil contains less clay and has weaker structure than that of the Nunn soils.

Profile of Fort Collins loam in an area of native grassland, approximately 1/4 mile east and 1/8 mile north of the SW. corner of sec. 24, T. 6 S., R. 57 W.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A3—2 to 5 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure breaking to very fine granular; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B2t—5 to 9 inches, grayish-brown (2.5Y 5/2) heavy loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure breaking to weak to moderate, medium, subangular blocky; hard when dry, friable when moist; many, thin, patchy clay films on both horizontal and vertical faces of soil aggregates; noncalcareous; gradual, smooth boundary.

B3—9 to 14 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; few, thin, patchy clay films, mainly on the vertical faces of soil aggregates; strongly calcareous; gradual, smooth boundary.

Cca—14 to 28 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; weak Ca horizon with visible calcium carbonate occurring as concretions and in thin seams and streaks; gradual, smooth boundary.

C—28 to 60 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, very friable when moist; strongly calcareous; less visible accumulated calcium carbonate than in the Cca horizon.

The texture of the A horizon ranges from loam to silt loam. The thickness of that horizon ranges from 2 to 5 inches. The texture of the B2 horizon ranges from heavy loam and light clay loam to light silty clay loam, and the thickness of that horizon ranges from 4 to 10 inches. The thickness of the solum ranges from 12 to 18 inches.

KUTCH SERIES

The Kutch series consists of moderately deep, grayish-brown, moderately fine textured and fine textured Chestnut soils. These soils developed in material weathered from dark-colored shale of the lower Dawson, Laramie, and Fox Hills formations. The underlying material normally consists of a massive layer of very dark grayish-brown clayey material that has weak to moderate accumulations of calcium carbonate and calcium sulfate. As depth increases the clayey material grades to very dark grayish-brown clayey shale. The Kutch soils mapped in this survey area are somewhat less well developed than the modal soils of the series.

The Kutch soils occur in the uplands. The slope range is 1 to 15 percent. The native vegetation includes western wheatgrass, blue grama, rabbitbrush, and cactus.

The Kutch soils have a B2 horizon, which the Christianburg soils lack. Also, the Kutch soils formed in shaly material, but the Christianburg soils formed in alluvium. The Kutch soils have a thicker solum and stronger horizonation than the Lismas soils. They are more clayey throughout than the Renohill soils.

Profile of a Kutch soil in an area of native grassland, approximately 450 feet east and 100 feet south of the NW. corner of the SW¼ of sec. 19, T. 10 S., R. 59 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—3 to 6 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist; weak, coarse, prismatic structure breaking to moderate, fine, angular blocky; very hard when dry, firm when moist; thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; noncalcareous; clear, smooth boundary.

B2t—6 to 14 inches, grayish-brown (2.5Y 5/2) heavy clay, very dark grayish brown (2.5Y 3/2) when moist; weak to moderate, coarse, prismatic structure breaking to moderate, medium, angular, blocky; extremely hard when dry, very firm when moist; thin, nearly continuous clay films on surfaces of the soil aggregates; noncalcareous; gradual, smooth boundary.

B3ca—14 to 19 inches, grayish-brown (2.5Y 5/2) heavy clay, very dark grayish brown (2.5Y 3/2) when moist; weak, coarse, subangular blocky structure; extremely hard when dry, very firm when moist; few, thin, patchy clay films, mainly on the vertical faces of the peds; noncalcareous; very weak Ca horizon with a small number of visible crystals of calcium carbonate and gypsum; gradual, smooth boundary.

Cca—19 to 23 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist; massive or very weak, coarse, subangular blocky structure; calcareous; moderate Ca horizon with visible calcium carbonate and some gypsum; gradual, smooth boundary.

C—23 to 32 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) when moist; massive or very weak, coarse, subangular blocky structure; very hard when dry, firm when moist; calcareous; some accumulated calcium carbonate and gypsum, but less than in the Cca horizon; many partly weathered shale fragments; grades into fine-textured shale.

The A horizon ranges from 3 to 6 inches in thickness. In areas that have not been disturbed, the uppermost 2 or 3 inches is clay loam. In areas that have been plowed, material from the subsoil has been mixed with material from the surface layer, and the texture is light clay. The B2t horizon ranges from 6 to 10 inches in thickness. The thickness of the solum ranges from 16 inches in moderately steep areas to 26 inches in nearly level areas.

LISMAS SERIES

This series consists of shallow or very shallow Lithosols. The Lismas soils mapped in this survey area are nearly like the modal soils of the series. They developed in material weathered from the underlying clayey and silty shale. The Lismas soils in the northern part of the survey area overlie lower Dawson and Laramie shale. They are darker colored than the Lismas soils in the southern part, whose color is nearly that of the modal soils of the series. The Lismas soils in the southern part of the survey area overlie Pierre shale. The soils that developed over lower Dawson shale are noncalcareous or only weakly calcareous throughout the profile, while those that developed over Pierre shale and Laramie shale are strongly calcareous or very strongly calcareous in most places. The horizon sequence is normally A1–AC–C–R.

These soils occur on uplands. The slope range is 3 to 15 percent. The native vegetation is western wheatgrass.

The Lismas soils are shallower, darker colored, and more clayey than the Midway and Bainville soils. They are much shallower than the Renohill soils, and their subsoil is less well developed than that of the Renohill soils.

Profile of Lismas clay in an area of grassland, about 300 feet north and 300 feet east of the SW. corner of the NW¼ of sec. 14, T. 8 S., R. 58 W.:

A1—0 to ½ inch, very dark gray (2.5Y 3/1) clay, very dark gray (2.5Y 3/1) when moist; strong, very coarse, granular structure; loose when dry, friable when moist, very plastic when wet; noncalcareous; abrupt, smooth boundary.

AC—½ inch to 4 inches, very dark gray (2.5Y 3/1) clay, black (2.5Y 2/1) when moist; weak, thick, platy structure breaking to weak, fine, subangular blocky; extremely hard when dry, very plastic when wet; noncalcareous; gradual, wavy boundary.

C—4 to 10 inches, very dark gray (2.5Y 3/1) clay, black (2.5Y 2/1) when moist; weak, thick, platy structure or massive; extremely hard when dry, friable when moist; noncalcareous; gradual, wavy boundary.

R—10 to 15 inches, slightly weathered or unweathered lenticular clayey shale.

The texture of the A horizon ranges from clay or silty clay to heavy clay loam or silty clay loam. The thickness of that horizon ranges from 1 to 4 inches.

MIDWAY SERIES

The Midway soils are shallow, clayey Regosols. They developed over calcareous, interbedded silty shale, clayey shale, fine-grained sandstone, and siltstone. These soils have an A1–AC–C–Cca horizon sequence. There are many crystals and pockets of gypsum and also splotches, streaks, and threads of lime.

These soils occur on uplands. The slope range is 3 to 15 percent. In the less sloping areas, the native vegetation includes western wheatgrass, sideoats grama, and little bluestem. In areas where the slopes are stronger, three-awn and blue grama are dominant.

The Midway soils are associated with the Renohill soils, from which they differ in lacking a B horizon.

Profile of Midway clay loam in a grassy area near the center of sec. 6, T. 13 S., R. 57 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, granular structure; slighlty hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

AC—3 to 7 inches, brown (10YR 5/3) clay loam, dark brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; strongly calcareous; gradual, smooth boundary.

C—7 to 12 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; strongly calcareous; gradual, smooth boundary.

Cca—12 to 15 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, subangular blocky; hard when dry, firm when moist; very strongly calcareous; gradual, smooth boundary.

C—15 to 24 inches, grayish-brown (2.5Y 5/2) clay loam, light yellowish brown (2.5Y 6/3) when moist; massive; hard when dry, firm when moist; strongly calcareous; gradual, smooth boundary.

R—24 inches +, stratified clayey and fine sandy Pierre shale; multicolored; calcareous; highly gypsiferous; generally soft, but a few thin layers are weakly indurated.

The texture of the A1 horizon ranges from silty clay loam to clay loam. The thickness of that horizon ranges from 2 to 4 inches.

The thickness of the solum ranges from 6 to 12 inches. The colors in the solum are shades of white, brown, reddish brown, and gray.

NUNN SERIES

This series consists of deep and moderately deep, grayish-brown Chestnut soils that are medium textured and moderately fine textured. These soils developed in mixed alluvium derived from loess and from shale and fine-grained sandstone of the Laramie and Fox Hills formations. The Nunn soils mapped in this survey area are fairly representative of the modal soils of the series, but their color and texture tend toward the minimal.

These soils occupy stream terraces and alluvial fans. The slope range is 0 to 5 percent. The native vegetation consists mainly of short grasses, such as blue grama, buffalograss, needlegrass, and western wheatgrass. Most of the vegetation consists of short grasses.

The Nunn soils have a B2 horizon, which the Christianburg soils lack. Their surface layer is thicker and darker colored than that of the Arvada soils, and they do not have the columnar structure in their B2 horizon that the Arvada soils have.

Profile of Nunn loam in an area of native grassland, approximately 250 feet south and 100 feet west of the NE. corner of the SE¼ of sec. 26, T. 6 S., R. 59 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 32) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—5 to 9 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to moderate, fine, subangular blocky; slightly hard when dry, very friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; noncalcareous; clear, smooth boundary.

B21t—9 to 14 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate to strong, fine, subangular blocky; very hard when dry, firm when moist; thin, continuous clay films on surfaces of the soil aggregates; noncalcareous; gradual, smooth boundary.

B22t—14 to 22 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, prismatic structure breaking to moderate, medium, angular and subangular blocky; very hard when dry, firm when moist; thin, continuous clay films on surfaces of the soil aggregates; noncalcareous; gradual, smooth boundary.

B3ca—22 to 28 inches, grayish-brown (2.5Y 5/2) light clay loam, dark grayish brown (2.5Y 4/2) when moist; weak to moderate, medium, subangular blocky structure; strongly calcareous; weak Ca horizon with some visible calcium carbonate as concretions; gradual, smooth boundary.

C—28 to 40 inches +, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, friable when moist; strongly calcareous; moderate Ca horizon with visible calcium carbonate as concretions and in thin seams and streaks.

The thickness of the A1 horizon ranges from 3 to 8 inches. In some areas, recent depositions of sandy material from adjacent slopes have changed the texture of the surface layer from loam to sandy loam. The thickness of the B2t horizon ranges from 6 to 14 inches.

PLATNER SERIES

This series consists of moderately deep and deep Planosols. These soils developed in sandy and gravelly, calcareous outwash mixed with loess. Most of the parent material was derived from the Ogallala formation, which is of Tertiary age, but some of the parent material appears to be of Pleistocene age.

The Platner soils mapped in this survey area are generally like the modal soils of the series, except that the colors generally have lower value and chroma. In most places the hue of the subsoil is 2.5Y. These soils normally have an A1–B2t–B3ca–Cca–C horizon sequence.

The slope range is 0 to 9 percent, but the soils that are most nearly representative of the series occur in areas where the slope is between 1 and 6 percent. The native vegetation consists of short grasses, mainly blue grama and buffalograss. Some little bluestem and western wheatgrass grow in the more sloping areas.

The Platner soils are less silty and more sandy and gravelly than the Weld soils. They have a claypan that is more firm than that of the Stoneham soils. Their subsoil contains more clay than the subsoil of those soils, and it has stronger structure.

Profile of Platner loam in an area of grassland, 500 feet east of the NW. corner of sec. 24, T. 10 S., R. 58 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak to moderate, fine, platy structure breaking to moderate, fine, granular; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A12—3 to 7 inches, brown (10YR 5/3) loam; dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure breaking to fine granular; hard when dry, friable when moist; gray coatings on particles in the lower part; noncalcareous; abrupt, smooth boundary.

A21t—7 to 15 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; strong, fine, prismatic structure breaking to strong, fine, angular blocky; very hard when dry, firm when moist; mod-

erate, continuous clay films on faces of peds; gray coatings on faces of peds in the upper part of the horizon; noncalcareous; clear, smooth boundary.

B22t—15 to 19 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) when moist; moderate to strong, medium, prismatic structure breaking to strong, medium, subangular blocky; very hard when dry, firm when moist; thin, continuous clay films on surface of peds; noncalcareous; gradual, smooth boundary.

B3ca—19 to 25 inches, light yellowish-brown (2.5Y 6/3) sandy clay loam, light olive brown (2.5Y 5/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; strongly calcareous; moderate Ca horizon with visible calcium carbonate in finely divided forms and as small concretions; gradual, smooth boundary.

Cca—25 to 42 inches, light yellowish-brown (2.5Y 6/3) sandy clay loam, light olive brown (2.5Y 5/3) when moist; massive to very weak, coarse, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; prominent Ca horizon with a large amount of accumulated calcium carbonate in thin seams and streaks and as concretions; gradual, smooth boundary.

C—42 to 60 inches, light yellowish-brown (10YR 6/4) heavy sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, friable when moist; strongly calcareous; less accumulated calcium carbonate than in the Cca horizon.

The texture of the A1 horizon ranges from loam to sandy loam. The thickness of that horizon ranges from 3 to 8 inches. The texture of the B2 horizon ranges from clay loam to sandy clay loam. Thickness of the B2 horizon ranges from 4 to 15 inches. The thickness of the solum ranges from 20 to 36 inches. Below a depth of 18 inches, the soils are weakly calcareous to very strongly calcareous.

RENOHILL SERIES

This series consists of moderately deep and deep, moderately fine textured Brown soils. These soils developed in material weathered from fine sandy shale and shaly sandstone of the Laramie, the Fox Hills, and the upper Pierre formations, modified in many places by deposits of loess or of loamy material carried by water.

These soils occur on uplands in areas where the slope range is 3 to 15 percent. The surface layer is thin, and the composite texture of this horizon and the subsurface layer is clay loam or loam. In areas where the soils are clayey, the native vegetation includes western wheatgrass, blue grama, galleta, and sacaton. In areas where the soils are loamy, the native vegetation consists of blue grama or a mixture of short grasses.

The Renohill soils are deeper than the Midway soils, and they have a B2t horizon, which the Midway soils lack. They have a thinner solum than the Ulm soils, and they contain less sand than those soils.

Profile of a Renohill soil in an area of native grassland, approximately 600 feet east and 300 feet south of the NW. corner of the SW¼ of sec. 4, T. 8 S., R. 58 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak, fine, subangular blocky structure breaking to moderate, fine, granular; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B21t—3 to 7 inches, grayish-brown (2.5Y 5/2) heavy clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate to strong, fine, prismatic structure breaking to moderate to strong, fine, subangular blocky; hard when dry, very friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; noncalcareous; clear, smooth boundary.

B22t—7 to 11 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/4) when moist; moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; very hard when dry, firm when moist; many, thin, patchy clay films on both horizontal and vertical faces of peds; very strongly calcareous; clear, smooth boundary.

B3ca—11 to 20 inches, olive-gray (5Y 5/2) heavy clay loam, olive gray (5Y 4/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, angular blocky; very hard when dry, firm when moist; many, coarse, prominent, light olive-brown (2.5Y 5/6) mottles; strongly calcareous; weak Ca horizon with some visible calcium carbonate as concretions; gradual, wavy boundary.

R—20 to 24 inches +, weakly weathered clayey shale; calcareous.

The texture of the B2t horizon ranges from clay loam and silty clay loam to clay. The thickness of that horizon ranges from 8 to 14 inches. The thickness of the solum ranges from 16 to 60 inches.

STONEHAM SERIES

This series consists of moderately deep, well-drained, moderately sandy Brown soils of the High Plains. These soils developed in sandy and gravelly, calcareous outwash. Most of the outwash is from the Ogallala formation, which is of Tertiary age, but some of the outwash appears to be of Pleistocene age.

The Stoneham soils in this survey area are moderately developed. The color is generally lighter than that of the modal soils of the series, the structure of the B2 horizon is less well defined, and the depth to lime is less. The color of the surface layer is lighter than very dark brown (10YR 2/2). The texture of the B horizon becomes sandier and the structure weaker as the climate becomes drier toward the southern part of the survey area. Lime is abundant in the lower part of the B horizon and the upper part of the C horizon. The slope range is 1 to 18 percent. The native vegetation is grass.

The Stoneham soils are sandier and lighter colored than the Platner soils, and they have a less well developed subsoil. They are less sandy than the Ascalon soils and are lighter colored in the surface layer. Their B2t horizon contains more silt and gravel than that of the Ascalon soils.

Profile of Stoneham sandy loam in an area of grassland, 200 feet east and 100 feet north of the SW. corner of the NW¼ of sec. 5, T. 12 S., R. 58 W.:

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; calcareous; clear, smooth boundary.

B2t—4 to 12 inches, light brownish-gray (10YR 6/2) heavy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; about 5 percent fine gravel; calcareous; clear, smooth boundary.

B3ca—12 to 15 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; about 5 percent gravel; strongly calcareous; weak Ca horizon with visible calcium carbonate as concretions and in finely divided forms; clear, wavy boundary.

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Cca—15 to 40 inches, very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) when moist; massive; hard when dry, friable when moist; 5 to 10 percent gravel; very strongly calcareous; strong or moderate Ca horizon with visible calcium carbonate in finely divided forms and as small concretions; gradual, wavy boundary.

C—40 to 60 inches, light-brown (7.5YR 6/4) light loam, brown (7.5YR 5/2) when moist; massive; hard when dry, friable when moist; strongly calcareous; less visible accumulated calcium carbonate than in the Cca horizon.

The thickness of the solum over the C horizon ranges from about 10 inches to 26 inches. The texture of the surface layer ranges from sandy loam or loam containing sand to heavy loamy sand. The texture of the subsoil ranges from loam or light clay loam to heavy sandy loam.

TERRY SERIES

This series consists of sandy, moderately deep Brown soils. These soils developed in residuum from fine-grained sandstone and siltstone of the Laramie and Fox Hills formations. The Terry soils mapped in this survey area are generally like the modal soils of the series.

The Terry soils occur on uplands. The slope range is 5 to 20 percent. The plant cover consists mainly of grasses, such as sand bluestem, sandreed, and little bluestem.

These soils are not so deep as the Vebar soils. They have a lighter colored surface layer than the Vebar soils, and they have calcium carbonate horizons, which the Vebar soils lack. They are coarser textured than the Ulm soils and have a less well defined structure in the B2 horizon.

Profile of Terry sandy loam in an area of native grassland, approximately 350 feet south and 50 feet west of the NE. corner of the SE¼ of sec. 16, T. 10 S., R. 58 W.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (2.5Y 4/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—4 to 7 inches, light olive-brown (2.5Y 5/3) heavy sandy loam, olive brown (2.5Y 4/3) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, very friable when moist; few, thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; noncalcareous; clear, smooth boundary.

B2t—7 to 15 inches, light olive-brown (2.5Y 5/3) light sandy clay loam, olive brown (2.5Y 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry, friable when moist; many, thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; weakly calcareous; gradual, wavy boundary.

B3ca—15 to 23 inches, light olive-brown (2.5Y 5/3) sandy loam, olive brown (2.5Y 4/3) when moist; weak, coarse, prismatic structure breaking to weak to moderate, coarse, subangular blocky; very hard when dry, friable when moist; few, thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; calcareous; gradual, wavy boundary.

Cca—23 to 36 inches, light olive-brown (2.5Y 5/3) sandy loam, olive brown (2.5Y 4/3) when moist; massive; hard when dry, very friable when moist; strongly calcareous; gradual, wavy boundary.

R—36 to 42 inches, partly weathered, soft sandstone; calcareous.

The color of the surface layer ranges from brown to grayish brown. The texture of the A horizon ranges from sandy loam to heavy loamy fine sand, and the thickness of that horizon ranges from 3 to 6 inches. The texture of the B2t horizon ranges from light fine sandy clay loam to heavy fine sandy loam. The thickness of that horizon ranges from 6 to 10 inches. The thickness of the solum ranges from 20 to 36 inches. The solum becomes shallower and somewhat lighter textured as the slope gradient increases.

TRUCKTON SERIES

This series consists of well-drained, moderately coarse textured Chestnut soils. These soils developed in arkosic, eolian sand, probably reworked alluvium and outwash derived from the Dawson formation. In most places these soils have a dark-colored A horizon and a weak textural B horizon. Normally they are noncalcareous, but they are slightly calcareous in places.

The slope range is 1 to 20 percent. The native vegetation is mainly sand bluestem, sandreed, and big bluestem, but blue grama and little bluestem also grow on these soils.

The Truckton soils have a textural B horizon, which the Blakeland soils lack. The Truckton soils are coarser textured than the Bresser soils and have weaker structure in their B2t horizon.

Profile of Truckton sandy loam in an area of native grassland, approximately 1,000 feet south of the NW. corner of the NE¼ of sec. 12, T. 9 S., R. 58 W.:

A11—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure breaking to very fine, granular or single grain; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A12—4 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—6 to 9 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; moderate, very coarse, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry, friable when moist; thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; noncalcareous; gradual, smooth boundary.

B2t—9 to 21 inches, grayish-brown (10YR 5/2) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, very coarse, prismatic structure breaking to weak, very coarse, subangular blocky; very hard when dry, friable when moist; thin, patchy clay films on both horizontal and vertical faces of the soil aggregates; noncalcareous; gradual, smooth boundary.

B3—21 to 31 inches, light olive-brown (2.5Y 5/3) sandy loam, olive brown (2.5Y 4/3) when moist; weak, coarse, subangular blocky structure; hard when dry, very friable when moist; thin, patchy clay films, principally on the vertical faces of the soil aggregates; noncalcareous; diffuse, smooth boundary.

C—31 to 60 inches, light yellowish-brown (2.5Y 6/3) loamy sand, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, very friable when moist; noncalcareous.

The texture of the surface layer ranges from sandy loam to loamy sand. The thickness of that horizon ranges from 4 to 8 inches. The texture of the B2t horizon ranges from sandy loam to sandy clay loam. The thickness of that horizon ranges from 4 to 14 inches. The consistence is hard or very hard when dry and friable or firm when moist.

TULLOCK SERIES

This series consists of shallow or very shallow Lithosols. The texture is uniformly loamy fine sand. These soils developed in residuum from fine-grained sandstone and siltstone of the Laramie and Fox Hills formations.

These soils occupy upland slopes and breaks. The slope range is 5 percent to more than 20 percent. The plant cover consists mainly of such grasses as sideoats grama, little bluestem, and blue grama. There is some buckwheat and yucca.

The Tullock soils are much shallower than the Terry soils. They lack a B2 horizon, which is present in the Terry soils. The Tullock soils are shallower than the Vebar soils, and they have a lighter colored A horizon. They developed in residual material, and the Vebar soils developed in windblown material.

Profile of Tullock loamy fine sand in an area of native grassland, approximately 500 feet west and 100 feet north of the SE. corner of the NE¼ of sec. 22, T. 7 S., R. 58 W.:

A11—0 to 4 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) when moist; single grain to very weak, fine, granular structure; soft when dry, very friable to loose when moist; noncalcareous; pH approximately 8.0; clear, smooth boundary.

A12—4 to 10 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; structureless (either single grain or massive); soft when dry, very friable when moist; calcareous in spots; gradual, smooth boundary.

AC—10 to 14 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; massive to very weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; calcareous; pH approximately 8.2; lower portion of horizon contains many partly weathered fragments of sandstone; gradual, smooth boundary.

C—14 to 18 inches, light-gray (10YR 7/2) loamy fine sand; grayish-brown (10YR 5/2) when moist; massive to very weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; strongly calcareous; pH approximately 8.4; clear, wavy boundary.

R—18 to 20 inches, moderately hard, shaly Tertiary sandstone and interbedded sandy shale; plant roots can penetrate only by following fractures.

The color of the surface layer ranges from pale brown to light brownish gray. The thickness of that horizon ranges from 3 to 10 inches. The color of the C horizon ranges from light gray to brown or yellowish brown. The C horizon ranges from slightly calcareous to strongly calcareous. The thickness of the combined A and AC horizons ranges from 6 to 18 inches over the bedrock. The color of the R horizon ranges from gray to yellowish brown.

ULM SERIES

This series consists of moderately deep, medium-textured and coarse-textured Brown soils. These soils developed in locally transported material or in residuum from soft, fine-grained sandstone, siltstone, and fine-grained sandy shale from the Fox Hills and Laramie formations. The Ulm soils mapped in this survey area are nearly modal for the series.

These soils occur on uplands. The slope range is 1 to 12 percent. The native vegetation is mainly western wheatgrass and blue grama.

The Ulm soils are deeper than the Renohill soils and are darker colored. Their B2t horizon is thicker and finer textured than that of the Terry soils and has a stronger structure.

Profile of Ulm loam in an area of native grassland, approximately 800 feet north and 1,100 feet east of the SW. corner of the NW¼ of sec. 13, T. 8 S., R. 57 W.:

A11—0 to 1 inch, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; abrupt, smooth boundary.

A12—1 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak medium, subangular blocky structure breaking to moderate, very fine granular; noncalcareous; clear, smooth boundary.

B1—3 to 8 inches, grayish-brown (10YR 5/2) light clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry, very friable when moist; thin, patchy clay films on surfaces of peds; noncalcareous; clear, smooth boundary.

B21t—8 to 15 inches, light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure breaking to moderate to strong, fine, angular blocky; very hard when dry, friable when moist; thin, continuous clay films on all surfaces of peds; noncalcareous; gradual, smooth boundary.

B22—15 to 22 inches, light olive-brown (2.5Y 5/3) heavy clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure breaking to moderate to strong, fine, angular blocky; very hard when dry, friable when moist; thin, nearly continuous clay films on all faces of peds; noncalcareous; gradual, smooth boundary.

B23t—22 to 29 inches, light olive-brown (2.5Y 5/3) heavy clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure breaking to moderate, fine, angular and subangular blocky; very hard when dry, friable when moist; thin, nearly continuous clay films on faces of peds; calcareous; gradual, wavy boundary.

B3ca—29 to 49 inches, pale-brown (10YR 6/3) light clay loam, grayish brown (10YR 5/2) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry, friable when moist; thin, patchy clay films on faces of peds; calcareous; moderate Ca horizon with visible concretions and seams of calcium carbonate; gradual, smooth boundary.

Cca—49 to 64 inches, light yellowish-brown (2.5Y 6/3) heavy fine sandy clay loam, light olive brown (2.5Y 5/3) when moist; massive; hard when dry, very friable when moist; strongly calcareous; weak Ca horizon with some visible concretions and thin seams of calcium carbonate; gradual, smooth boundary.

C—64 to 72 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) when moist; massive; strongly calcareous; less calcium carbonate than in the Cca horizon.

The texture of the surface layer ranges from very fine sandy loam to loam. The thickness of that layer ranges from 2 to 5 inches. The texture of the B2t horizon is heavy clay loam. The thickness of that horizon ranges from 17 to 24 inches. The thickness of the solum ranges from 38 to 54 inches.

VEBAR SERIES

This series consists of moderately deep Chestnut soils. These soils developed in local, wind-deposited valley fill, of fine sandy texture, that weathered from sandstone of the Fox Hills and Laramie formations. The Fox Hills sandstone is generally noncalcareous, but Laramie sandstone is weakly calcareous to strongly calcareous; consequently, some of the Vebar soils are noncalcareous, but others are weakly calcareous.

The B horizon is only weakly developed; the content of clay is nearly the same as that of the A horizon. In an undisturbed profile, the horizon sequence is A1–B2t–B3–C.

The Vebar soils occur in uplands. The slope range is 3 to 20 percent. The native vegetation includes sand bluestem, big bluestem, and sandreed.

The Vebar soils contain more fine sand and very fine sand than the Terry and Truckton soils. Their B horizon has a coarser texture than that of the Truckton soils. They are deeper than the Terry and Tullock soils and more strongly developed than the Tullock soils.

Profile of Vebar loamy fine sand in an area of native grassland, about 1,400 feet south and 900 feet east of the NW. corner of sec. 19, T. 8 S., R. 57 W.:

- A1—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.
- A3—6 to 10 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
- B2t—10 to 22 inches, brown (10YR 5/3) light fine sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak to moderate, coarse, subangular blocky; hard when dry, very friable when moist; thin, patchy clay skins on faces of peds; noncalcareous; gradual, smooth boundary.
- B3—22 to 32 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.
- C—32 to 60 inches +, light yellowish-brown (2.5Y 6/3) fine sand, light olive brown (2.5Y 5/3) when moist; massive; soft when dry, very friable when moist; noncalcareous.

The texture of the A horizon ranges from fine sand to loamy fine sand. In most places the color of the A horizon is grayish brown, but in some winnowed areas, the color ranges to light brownish gray or light gray. If the soil has not been disturbed, the surface layer ranges from 8 to 12 inches in thickness. The subsoil ranges from 10 to 22 inches in thickness and from light fine sandy loam to heavy loamy fine sand in texture.

WELD SERIES

This series consists of moderately deep to deep, medium-textured or fine-textured Planosols. These soils developed in calcareous, silty loess that has been altered in places by the addition of Tertiary outwash and sandy material weathered from sandstone.

The Weld soils that occur in parts of this survey area where the average annual precipitation is greater are nearly like the modal soils of the series. The Weld soils that occur in significantly drier areas have a lighter colored surface layer than the modal soils, a thinner, lighter colored subsoil, and deposits of lime nearer the surface. In an undisturbed profile, the horizon sequence is A1–B2t–B3ca–Cca–C.

These soils occur on benches and ridges in the uplands. The slope range is 0 to 9 percent. The native vegetation consists of such short grasses as blue grama and buffalograss.

The Weld soils contain more silt and less sand and fine gravel than the Platner soils. They are darker colored than the Baca soils. Their subsoil is more clayey and better developed than that of those soils.

A profile of Weld loam in an area of grassland, 0.4 mile east of the SW. corner of sec. 33, T. 10 S., R. 58 W.:

- A11—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
- A12—4 to 7 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak to moderate, coarse, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; gray coatings on surfaces of peds; noncalcareous; abrupt, smooth boundary.
- B21t—7 to 9 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure breaking to strong, fine and very fine, angular blocky; very hard when dry, friable when moist; thin, continuous clay films on faces of peds; noncalcareous; clear, smooth boundary.
- B22t—9 to 15 inches, brown to dark-brown (10YR 4/3) silty clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure breaking to strong, fine, angular blocky; extremely hard when dry, very firm when moist; continuous clay films on faces of peds; noncalcareous; gradual, smooth boundary.
- B23t—15 to 20 inches, grayish-brown (2.5Y 5/2) light silty clay, dark grayish brown (2.5Y 4/2) when moist; strong, medium, prismatic structure breaking to strong, fine, angular blocky; extremely hard when dry, very firm when moist; continuous clay films on faces of peds; noncalcareous; clear, smooth boundary.
- B3ca—20 to 29 inches, light brownish-gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/3) when moist; moderate, medium, prismatic structure breaking to moderate, medium, angular blocky; very hard when dry, firm when moist; thin, patchy clay films, mainly on vertical faces of peds; strongly calcareous; moderate Ca horizon with visible calcium carbonate occurring as concretions and in thin seams and streaks; clear, smooth boundary.
- Cca—29 to 33 inches, light brownish-gray (2.5Y 6/2) light silty clay loam, light olive brown (2.5Y 5/3) when moist; massive; hard when dry, friable when moist; strongly calcareous; moderate to strong Ca horizon with visible lime occurring in finely divided forms and as concretions; gradual, smooth boundary.
- C—33 to 60 inches +, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist; strongly calcareous; some accumulated lime but less than in the Cca horizon.

The deeper areas of the Weld soils are around Cedar Point and Matheson, where the average annual precipitation is more than 15 inches. In those areas the depth to lime is generally more than 18 inches. The surface layer ranges from 5 to 8 inches in thickness. In color, this layer ranges from grayish brown (10YR 5/2) to dark grayish brown (10YR 4/2) when dry and from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) when moist. The subsoil ranges from silty clay loam to silty clay in texture and from 8 to 16 inches in thickness. In color, it ranges from grayish brown (10YR 5/2) to dark brown (10YR 4/3) when dry and from dark grayish brown (10YR 4/2) to brown (10YR 5/3) when moist.

In the parts of the survey area that receive less precipitation, the depth to lime is only about 15 inches. The surface layer in these areas is 3 to 5 inches thick. In color, it ranges from grayish brown (10YR 5/2) to brown (10YR 5/3) when dry and from dark yellowish brown (10YR 3.5/2) to brown (10YR 4/3) when moist. The subsoil ranges from heavy clay loam to silty clay in texture and from 8 to 13 inches in thickness. In color, it ranges from light brownish gray (10YR 6/2) to brown (10YR 5/3) when dry and from brown (10YR 5/3) to dark brown (10YR 4/3) when moist. In some profiles the subsoil has a hue of 2.5Y.

WILEY SERIES

This series consists of moderately deep, Brown soils of the High Plains. These soils developed in silty, strongly calcareous loess. The parent material has been altered in many places by the addition of local windblown material of fine sandy texture. The Wiley soils mapped in this survey area contain less silt and more sand than the modal soils of the series.

In an undisturbed profile, the horizon sequence is normally A1–B1–B2tca–B3ca–Cca–C. In most places the A horizon is calcareous throughout, but in a few places the uppermost 2 or 3 inches is leached. Generally, the B horizon is strongly calcareous throughout. Both the B and the C horizons have more yellow and olive colors than the modal soils of the series.

The Wiley soils occur on uplands. The slope range is 3 to 18 percent. The native vegetation consists of short grasses, mainly blue grama. Where there is enough moisture, little bluestem and sideoats grama grow also.

The Wiley soils are less clayey than the Baca soils and somewhat lighter colored. Their B horizon has a less well-defined structure than that of the Baca soils. They are more clayey than the Colby soils.

Profile of Wiley loam in an area of grassland, about 150 feet south of the NW. corner of the NE¼ of sec. 25, T. 9 S., R. 58 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) loam; dark grayish brown (10YR 4/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; clear, smooth boundary.

B2tca—3 to 13 inches, light yellowish-brown (2.5Y 6/3) light clay loam, light olive brown (2.5Y 5/3) when moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; thin, patchy clay films on peds; strongly calcareous; some concretions; gradual, smooth boundary.

B3ca—13 to 29 inches, light yellowish-brown (2.5Y 6/3) loam or very fine sandy loam; light olive brown (2.5Y 5/3) when moist; weak to moderate, coarse, prismatic structure breaking to weak to moderate, coarse, subangular blocky; hard when dry, very friable when moist; thin, patchy clay films on vertical faces of peds; strongly calcareous; weak Ca horizon; diffuse, wavy boundary.

C—29 to 60 inches, light yellowish-brown (2.5Y 6/3) loam or very fine sandy loam; light olive brown (2.5Y 5/3) when moist; massive; hard when dry, very friable when moist; very strongly calcareous; lime well disseminated.

The texture of the A horizon ranges from very fine sandy loam to silt loam. The color of that horizon ranges from light brownish gray to grayish brown, and the thickness from 2 to 4 inches. The thickness of the B horizon ranges from 10 to 23 inches. The thickness decreases as the slope gradient increases.

YODER SERIES

This series consists of well-drained to excessively drained, very gravelly Brown soils. Generally, these soils are neutral and noncalcareous, but in some places they are slightly calcareous. These soils developed in very gravelly Tertiary or Pleistocene channel fill or pedisediments overlying a substratum of sand and gravel of very low water-holding capacity.

These soils normally have an A1–B2t–B3–C horizon sequence. In an undisturbed profile, the A horizon is moderately dark colored and granular. In a plowed area, the texture of the surface layer is more nearly sandy loam than loamy sand. The B2 horizon has prismatic or subangular blocky structure. The C horizon, which is at a depth of no more than 60 inches, consists of sand and gravel and has low water-holding capacity.

These soils occupy ridges and the crests of high terraces. The slope range is 5 to 25 percent. The native vegetation is principally big bluestem, needlegrass, mountain muhly, little bluestem, blue grama, yucca, and weeds.

Profile of a Yoder soil along U.S. Highway No. 24, approximately 300 feet south of the NE. corner of the SE¼ of sec. 16, T. 10 S., R. 58 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft when dry; very friable when moist; noncalcareous; approximately 25 percent fine gravel; clear, smooth boundary.

B2t—3 to 9 inches, brown (10YR 5/3) fine gravelly clay loam, brown or dark brown (10YR 4/3) when moist; weak, fine, prismatic structure breaking to moderate, fine, subangular blocky; slightly hard when dry, very friable when moist; thin, nearly continuous clay films on the surfaces of the peds; noncalcareous; clear, smooth boundary.

B3—9 to 12 inches, light-brown (7.5YR 6/3) gravelly loamy sand, brown (7.5YR 4/3) when moist; single grain; slightly hard when dry, very friable when moist; clay films coat the peds; noncalcareous; abrupt, smooth boundary.

C—12 to 60 inches +, very pale brown (10YR 7/4) stratified coarse sand and gravel; light yellowish brown (10YR 6/4) when moist; noncalcareous; very low water-holding capacity.

The clay content of the B2t horizon ranges from 17 to 35 percent, the silt content from 10 to 45 percent, and the sand content from 25 to 65 percent. The gravel content of the solum is more than 25 percent in most places. The upper part of the C horizon is weakly calcareous in some places, probably as a result of the movement of ground water.

General Nature of the Area

White settlers established their first outpost in what is now the eastern part of Elbert County in 1858. Antelope, deer, and buffalo roamed the plains, and the area was used as a hunting ground by the Indians. One of the first permanent settlements was established near the place where Big Sandy Creek, the largest stream in the area, changes its course from northeast to southeast. This community was named River Bend.

The Smoky Hill Stage operated a route through the area in the early days. The stage was succeeded by the railroad, which began service through the territory in 1870 and covered roughly the same route as the stage.

Elbert County was organized in 1874 from portions of Douglas and Greenwood Counties, both of which were then a part of Kansas. White settlements were established in the southern part of the survey area as early as 1879, and by 1905 most of the land desirable for homesteading had been claimed. Few of these early communities still exist.

Most of the communities that survived the early hazards of famine, blizzards, and Indian raids fell victim to the disastrous duststorms of the 1930's. The principal communities now are Agate (population 150) and Matheson (population 150).

Geology [5]

Most of the eastern part of Elbert County lies within the Colorado Piedmont section of the Great Plains. A small area in the northeastern part lies within the Central High Plains. The highest point, near Agate, is about 6,300 feet above sea level. The lowest point, where Beaver Creek leaves the area, is about 5,200 feet above sea level.

The eastern part of Elbert County is drained by tributaries of the South Platte, Arikaree, and Arkansas Rivers. The principal stream in the survey area is Big Sandy Creek, which flows from west to east and drains the central part. East Bijou Creek and Beaver Creek drain the northern part. The southern part is drained by Rush Creek, Mustang Creek, Horse Creek, and Little Horse Creek.

All of the streams are intermittent, but they carry a large quantity of water after heavy rainfall in summer and after snowmelt early in spring. Considerable subsurface water flows through the sand of many of the streambeds. Formerly, all of the streambeds were stabilized by a cover of native grasses and had little or no definite channel. Cultivation of the soils, the replacing of grassed areas by roadways, and overgrazing of pastures have increased the amount of runoff. Consequently, most of the streams in the area now actively cut into their banks and deposit soil material along their entire course on ever-widening sandy flood plains.

The northern and central parts of the survey area generally have broadly rolling topography, particularly in areas that have soft sandstone and shale of Cretaceous and Tertiary age near the surface. In the northeastern part, in the area drained by Beaver Creek, the bedrock formations have been deeply dissected, and in places the topography is like that of badlands. South of the Beaver Creek drainage area, the flat, northeast-sloping plain formed by the Ogallala formation marks the westernmost extension in Colorado of the High Plains section of the Great Plains physiographic province. The southern part of the area, where the unconsolidated upland gravel has not been removed from the underlying Cretaceous beds, is a plain that slopes southeastward and has been dissected in many places by small streams.

Sedimentary rocks crop out in many places. They range in geologic age from Upper Cretaceous to Recent. In many areas the Upper Cretaceous and Tertiary formations lie at or near the surface (fig. 22). The oldest upper Cretaceous rocks are parts of Pierre shale, Fox Hills sandstone, the Laramie formation, and the lower

[5] By ALEX D. ELKIN, geologist, Soil Conservation Service.

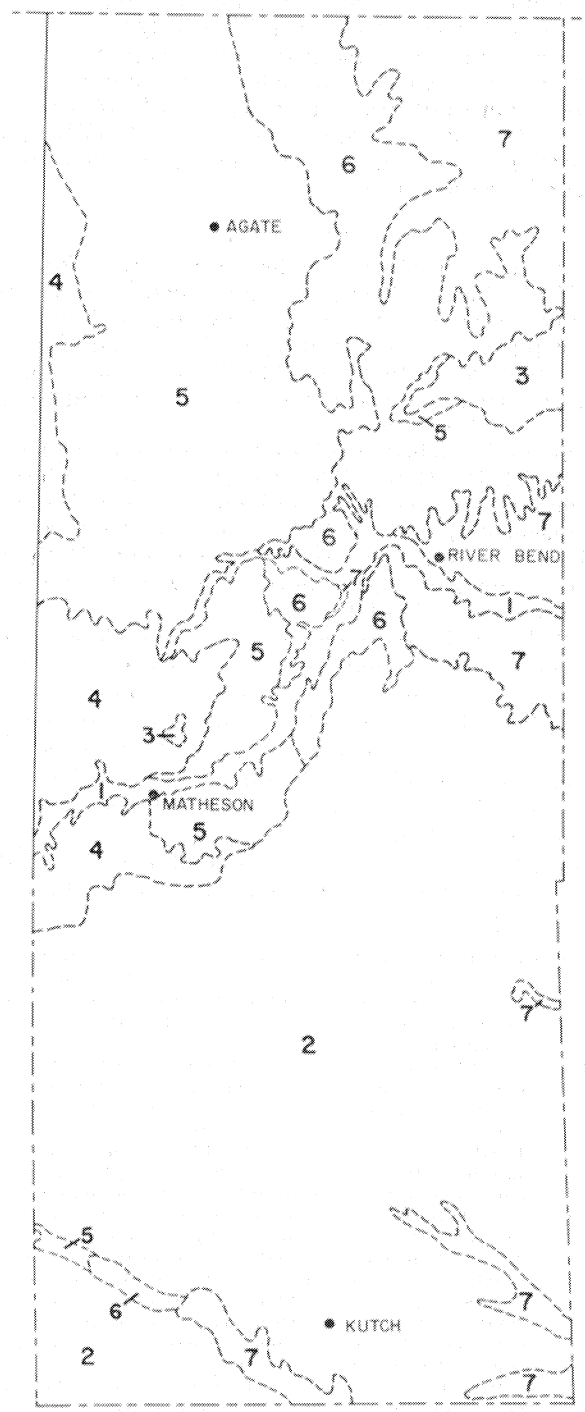


***Figure 22.*—Geological map of the eastern part of Elbert County. Surficial Pleistocene and Recent deposits mantle much of the upland area but are not shown. Legend: 1—Alluvium along Big Sandy Creek and Willow Gulch. Other alluvium not shown. 2—Upland gravel. 3—Ogallala formation. 4—Dawson formation. 5—Laramie formation. 6—Fox Hills sandstone. 7—Pierre shale. Terrace deposits, loess, dune sand, and colluvial deposits not shown.**

Dawson formation. The Ogallala formation and part of the lower Dawson formation are of Tertiary age. Upland gravel in the southern part of the area is of late Pliocene or early Pleistocene age. Late Pleistocene terrace deposits occur in the valley along the major streams. Eolian deposits of Pleistocene and Recent age mantle much of the upland area. Recent alluvium has been deposited in most stream valleys.

The subbituminous coal that occurs in the Laramie formation is the principal mineral resource of the area. Coal reserves of the entire county are estimated to be 205 million tons, and at least half is in the eastern part. Several coal mines are worked in the area, but coal is produced only for local consumption. Some mines have been abandoned.

The area has not been thoroughly tested for oil. Some wells have been drilled, but none has been productive.

Ground water is an important resource. The main water-bearing formations are the valley-fill deposits in the principal valleys. These deposits, which consist primarily of beds of sand and gravel, yield varying quantities of hard water, which is used mainly for domestic purposes and for watering livestock. Some of the water is used for irrigating cropland in the valleys along Big Sandy Creek, but the areas are not extensive. In 1957 less than a thousand acres was irrigated.

Climate

The climate of the survey area is continental. Rainfall is light, and relative humidity is low. Variations in temperature are extreme at times, and wind movement is strong throughout the greater part of the year. The average annual precipitation decreases and the mean temperature increases from north to south.

About 80 percent of the annual precipitation occurs in spring and summer. At Calhan (fig. 23) the wettest months are August, with an average of 2.92 inches, and July, with an average of 2.62 inches. At Hamps the average for July is 2.54 inches, and the average for August is 2.22 inches. At the weather substation near Limon the highest monthly average (fig. 24) is 2.28 inches for July, and the second highest is 2.06 inches for May. At Long Branch, the wettest months are August, with an average of 2.20 inches, and May, with an average of 2.09 inches.

The weather stations at Calhan and Hamps and the substation near Limon have recorded snowfall in every month except July and August. The station at Long Branch, in nearby Lincoln County, records both of these months as snow free, and the month of September as well. The amount of snowfall decreases rapidly as the elevation decreases. At Calhan the annual average amount of snowfall is 48.7 inches. At Hamps it is 36.1, at the substation near Limon it is 29.1 and at Long Branch it is 29.2.

The long-term distribution of precipitation does not create favorable growing conditions. A year in which there is a large amount of rainfall may be followed by a year of drought. For example, in 1933 the amount of precipitation recorded at Calhan was 23.63 inches. In the following year, 1934, the total recorded at the same station was 5.52. Records at weather stations in the survey area and nearby counties show that annual precipitation is below the annual average about 60 percent of the time. Seasonal and monthly variations are also extreme.

Periods of drought are frequent. Dry spells have been recorded during which less than 1 inch of rain has fallen in a period as long as 5 months. The longer drought periods are usually in fall and winter. Dry periods lasting 4 to 8 weeks in spring and summer are not unusual, however, and these are more injurious to crops and range grasses than longer droughts in winter.

On the other hand, local rainstorms are frequently torrential, and considerable damage is caused by flash floods and erosion resulting from runoff. The geographic distribution of rainstorms is erratic. During the same period of time, one locality may have a considerably greater amount of rainfall than another place only a few miles away.

Hailstorms are most likely to occur during August and September but may occur at any time during spring and summer. Many are accompanied by high winds that destroy standing crops.

Loss of moisture by evaporation is high. Observations made by the Bureau of Public Roads at Denver of evaporation from a 12-foot land pan showed a loss of 47.19 inches for the period March through November. Losses in the survey area would probably be greater, because the wind velocity is slightly higher than at Denver, and the location is more exposed.

The prevailing winds are southerly. Northeasterly winds are most common during the months of December, January, February, March, and April.

The mean annual temperature at the weather substation near Limon is 46.2° F. The seasonal means are 30.6° in winter, 54.2° in spring, 65.8° in summer, and 37.2° in fall. The lowest temperature on record is −30°, and the highest is 101°.

Records at the substation near Limon are representative of the areas as a whole. According to these records the average length of the growing season is 138 days. Frost has been recorded as early in fall as September 19 and as late in spring as June 5. The average date of the latest killing frost in spring is May 17, and that of the first killing frost in fall is October 2.

Agriculture

Homestead land in this survey area was used at first as open range for grazing livestock. During the period between 1870 and 1875, small areas were broken out of sod and used to raise cultivated crops for home use and for use as supplemental feed, but cultivated crops did not become common until after 1900. During and after World War I, large acreages were plowed up and planted to wheat and pinto beans, both of which are still important crops. It was at this time that spring-planted wheat was replaced with winter wheat.

As the acreage of cropland increased, the acreage of rangeland decreased. More and more cattle grazed on smaller areas of range, and much of the grassland was used beyond its permanent carrying capacity. The adverse effects of overstocking the range were not recognized by ranchers until the seriousness of the situation was made evident by the prolonged drought of the 1930's.

Farming methods have gradually changed in this area, and cropping systems have been revised, but raising livestock is still the main agricultural enterprise. Most

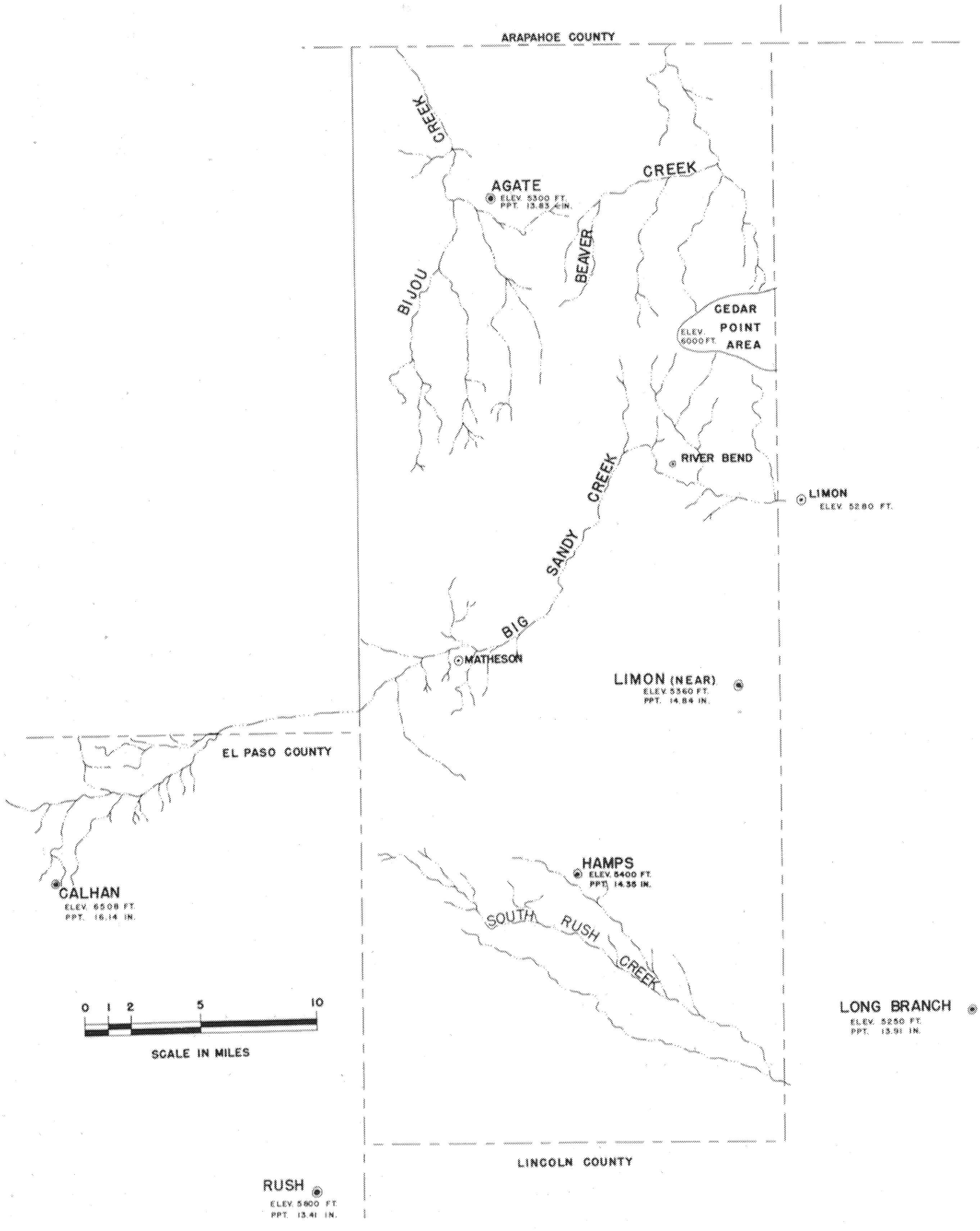


Figure 23.—Location of weather stations in or near the survey area. "PPT." stands for average annual precipitation.

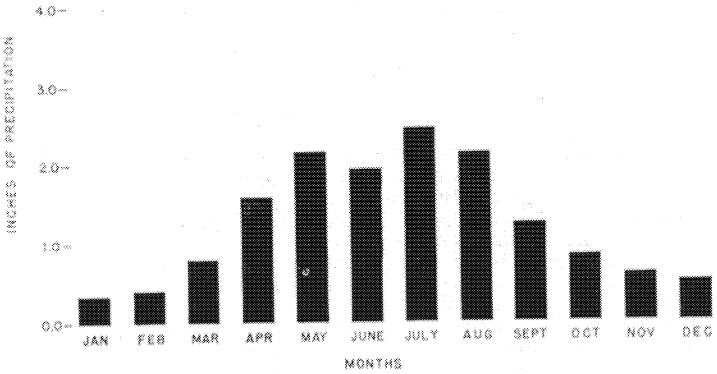


Figure 24.—**Average monthly precipitation at the weather substation near Limon.**

of the acreage is used for range and pasture, and many areas of deteriorated range are being reseeded to grass. Wheat is the main cultivated crop. The acreage of forage sorghum, which is used as supplemental feed for livestock, has been on the increase. Other important crops are pinto beans, barley, and corn. Corn is grown mostly for livestock feed.

Transportation and Markets

Two railroads cross the survey area; they pass through Agate and Matheson, respectively. Interstate bus and truck lines operate along U.S. Highways No. 40 and No. 24.

The area is thoroughly transected by State and County roads that provide ready access to markets and shopping centers. The chief markets for grain and livestock outside of the survey area are Denver, Kansas City, Mo., and Omaha, Nebr.

About 160 miles of State and Federal highways, most of which are of concrete or bituminous construction, serve the central and northwestern communities. Many miles of county and local roads, mostly of earth construction and kept in good repair, also serve the area. All the roads in the southern part of the survey area are dirt roads.

Glossary

Aggregate (soil structure). Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. A series of discontinuous rises that gives the landscape a stairstep appearance.

Chisel. A tillage implement that has one or more soil-penetrating points that can be drawn through the soil to loosen or shatter the subsoil to a depth as great as 36 inches. A chisel is used for emergency tillage. The clods it brings to the soil surface deflect erosive winds.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt. (See also Sand, Silt, and Texture.)

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Colluvium (colluvial material). A mixture of soil material and coarser material moved mainly by gravitation, creep, and local wash and deposited at the foot of slopes.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concretions of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose. Noncoherent; will not hold together in a mass.

Friable. When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, readily deformed by moderate pressure, but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard. When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft. When dry, breaks into powder or individual grains under very slight pressure.

Dryland farming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. The soil ordinarily is tilled for at least one growing season to control weeds and to aid in the decomposition of plant residues.

Gravelly soil. Soil that is 15 to 50 percent, by volume, rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

Listing. A method of tillage in which the plowshares throw the soil in opposite directions and leave the field with alternate ridges and furrows. Used to roughen the surface for protection against wind erosion.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Parent material. The horizon of weathered rock or partly weathered soil material from which a soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Pedisediments. A layer of translocated, till-like sediment covering an erosion surface (pedisediment) at the foot of a receded slope that is underlain by rocks or sediments of the upland.

Permeability. The quality of a soil that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid,* and *rapid.*

Plow layer. That part of the soil profile moved in tillage; equivalent to surface layer.

Profile, soil. A vertical section of the soil through all of its horizons and extending into the parent material. (See Horizon, soil.)

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. In words the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff. Surface drainage of rainfall or melted snow.

Salinity. As used in this soil survey, salinity ratings are based on the electrical conductivity of saturated soil extract and expressed in millimhos per centimeter at 25° C. The following ratings were assigned:

Salinity	*Millimhos per cm.*
None	Less than 2.0
Slight	2.0 to 4.0
Moderate	4.0 to 8.0
Severe	8.0 to 16.0
Very severe	More than 16.0

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that is 85 percent or more sand and not more than 10 percent clay. (See also Clay, Silt, and Texture.)

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay. (See also Clay, Sand, and Texture.)

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate, and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. Stubble or other crop residues left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Stubble-mulch tillage. A method of tillage that loosens the subsoil and eradicates weeds by using subtillage sweeps, but leaves the crop stubble generally undisturbed.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil. (See also Horizon, soil; and Parent material.)

Surface layer. Technically, the A horizon; commonly, the part of the soil ordinarily moved by plowing. (See also Plow layer.)

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles are as follows: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine." (See also Clay, Sand, and Silt.)

Tillage pan. A dense, highly compact soil zone occurring just below normal tillage depth; caused by tilling when the soil is too wet.

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water-holding capacity. Water-holding capacity, as used in this report, refers to the field capacity of the soil. When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Water spreaders. Dams, dikes, or diversions used to conduct water from natural channels to spread over relatively flat areas.

GUIDE TO MAPPING UNITS

[See table 1, p. 5, for tne approximate acreage and proportionate extent of the soils; table 2, p. 30 for predicted average acre yields of principal crops grown in climatic zone B; and table 3, p. 31, for predicted average acre yields of principal crops grown in climatic zone C; for information significant in engineering, see the section beginning on p. 39]

Map symbol	Mapping unit	Page	Capability unit: Climatic zone B	Page	Capability unit: Climatic zone C	Page	Range site: Name	Page	Windbreak group: Group	Page
AaA	Arvada loam, 0 to 3 percent slopes--	4	(1/)	--	VIs-1	28	Salt Flats	34	5	38
AcB2	Arvada complex, 0 to 3 percent slopes, eroded------------------	4	(1/)	--	VIIs-1	29	Salt Flats	34	5	38
AnB	Ascalon sandy loam, 1 to 3 percent slopes-------------------------	5	IIIe-2	24	IVe-5	26	Sandy Plains	32	3	38
AnC	Ascalon sandy loam, 3 to 5 percent slopes-------------------------	6	IIIe-3	25	IVe-6	26	Sandy Plains	32	3	38
AnD	Ascalon sandy loam, 5 to 9 percent slopes-------------------------	6	IVe-1	25	VIe-1	27	Sandy Plains	32	3	38
AnE	Ascalon sandy loam, 9 to 15 percent slopes-------------------------	6	(1/)	--	VIe-1	27	Sandy Plains	32	3	38
ApB2	Ascalon complex, 1 to 3 percent slopes, eroded------------------	6	(1/)	--	VIe-2	27	Sandy Plains	32	3	38
ApC2	Ascalon complex, 3 to 5 percent slopes, eroded------------------	6	(1/)	--	VIe-2	27	Sandy Plains	32	3	38
BaC	Baca loam, 3 to 5 percent slopes----	6	IIIe-1	24	IVe-3	26	Loamy Plains	33	1	37
BaE	Baca loam, 5 to 15 percent slopes---	6	(1/)	--	VIe-4	27	Loamy Slopes	33	1	37
BcE2	Baca complex, 5 to 15 percent slopes-------------------------	6	(1/)	--	VIe-5	27	Loamy Slopes	33	1	37
Bd	Badlands-------------------------	7	(1/)	--	VIIIe-1	30	(2/)	--	5	38
Be	Blakeland loamy sand---------------	7	(1/)	--	VIe-8	28	Deep Sand	31	2	38
Bk	Breaks-Alluvial land complex-------	7	(1/)	--	VIIIe-2	30	(2/)	--	5	38
BmB	Bresser sandy loam, 1 to 3 percent slopes-------------------------	8	IIIe-2	24	IVe-5	26	Sandy Grassland	34	3	38
BmC	Bresser sandy loam, 3 to 5 percent slopes-------------------------	8	IIIe-3	25	IVe-6	26	Sandy Grassland	34	3	38
BmD	Bresser sandy loam, 5 to 9 percent slopes-------------------------	8	IVe-1	25	VIe-9	28	Sandy Grassland	34	3	38
BmE	Bresser sandy loam, 9 to 15 percent slopes-------------------------	8	(1/)	--	VIe-9	28	Sandy Grassland	34	3	38
BrC2	Bresser complex, 3 to 5 percent slopes, eroded------------------	8	(1/)	--	VIe-2	27	Sandy Grassland	34	3	38
BtD	Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes------------	8	(1/)	--	VIe-9	28	Sandy Grassland	34	3	38
CbA	Christianburg clay, 0 to 3 percent slopes-------------------------	9	(1/)	--	VIs-1	28	Salt Flats	34	5	38
CbB3	Christianburg clay, 0 to 3 percent slopes, severely eroded----------	9	(1/)	--	VIIs-1	29	Salt Flats	34	5	38
CbC	Christianburg clay, 3 to 5 percent slopes-------------------------	9	(1/)	--	VIe-6	28	Clayey Plains	33	5	38
ChA	Christianburg sandy loam, 0 to 3 percent slopes-----------------	9	(1/)	--	IVe-4	26	Loamy Plains	33	3	38
EaA	Eastonville loamy sand, 0 to 3 percent slopes---------------------	9	(1/)	--	VIe-9	28	Sandy Grassland	34	2	38
EaC	Eastonville loamy sand, 3 to 5 percent slopes---------------------	9	(1/)	--	VIe-9	28	Sandy Grassland	34	2	38
FcA	Fort Collins loam, 0 to 3 percent slopes-------------------------	10	(1/)	--	IVe-2	25	Loamy Plains	33	1	37

GUIDE TO MAPPING UNITS--Continued

Map symbol		Page	Capability unit: Climatic zone B	Page	Capability unit: Climatic zone C	Page	Range site: Name	Page	Windbreak group: Group	Page
Gr	Gravelly land	10	(1/)	--	VIIs-2	30	Gravel Breaks	34	5	38
KcC	Kutch clay, 1 to 5 percent slopes	10	(1/)	--	VIe-6	28	Clayey Plains	33	5	38
KcE	Kutch clay, 5 to 15 percent slopes	10	(1/)	--	VIe-6	28	Clayey Plains	33	5	38
KcE3	Kutch clay, 5 to 15 percent slopes, severely eroded	10	(1/)	--	VIIe-2	29	Clayey Plains	33	5	38
Lc	Lismas clay	11	(1/)	--	VIs-2	28	Shale Breaks	33	5	38
Lc2	Lismas clay, eroded	11	(1/)	--	VIIe-4	29	Shale Breaks	33	5	38
Lo	Loamy alluvial land	11	(1/)	--	VIw-1	29	Overflow	34	4	38
Mb	Midway-Bainville complex	11	(1/)	--	VIe-4	27	Loamy Slopes	33	5	38
Mb2	Midway-Bainville complex, eroded	11	(1/)	--	VIe-5	27	Loamy Slopes	33	5	38
Mu	Midway-Ulm complex	11	---	--	-----	--	-----------	--	--	--
	Midway	--	(1/)	--	VIe-4	27	Loamy Slopes	33	5	38
	Ulm	--	(1/)	--	VIe-4	27	Loamy Slopes	33	1	37
Mu3	Midway-Ulm complex, severely eroded	11	(1/)	--	VIIe-4	29	Shale Breaks	33	5	38
NmA	Nunn loam, 0 to 3 percent slopes	12	(1/)	--	IVe-2	25	Loamy Plains	33	1	37
NmC3	Nunn loam, 3 to 5 percent slopes, severely eroded	12	(1/)	--	VIe-3	27	Loamy Plains	33	1	37
NnA	Nunn sandy loam, 0 to 3 percent slopes	12	(1/)	--	IVe-4	27	Loamy Plains	33	1	37
PmA	Platner loam, 0 to 1 percent slopes	12	(1/)	--	IVe-2	25	Loamy Plains	33	1	37
PmB	Platner loam, 1 to 3 percent slopes	12	(1/)	--	IVe-2	25	Loamy Plains	33	1	37
PmC	Platner loam, 3 to 5 percent slopes	12	(1/)	--	IVe-3	26	Loamy Plains	33	1	37
PmD	Platner loam, 5 to 9 percent slopes	12	(1/)	--	VIe-3	27	Loamy Plains	33	1	37
PsB	Platner-Ascalon sandy loams, 0 to 3 percent slopes	12	(1/)	--	IVe-5	26	Sandy Plains	32	3	38
PsC	Platner-Ascalon sandy loams, 3 to 5 percent slopes	13	(1/)	--	IVe-6	26	Sandy Plains	32	3	38
Rc	Renohill clay loam	13	(1/)	--	VIe-6	28	Clayey Plains	33	5	38
ReE2	Renohill complex, 3 to 15 percent slopes, eroded	13	(1/)	--	VIIe-2	29	Clayey Plains	33	5	38
Rh	Riverwash	13	(1/)	--	VIIIs-1	30	(2/)	--	5	38
Rn	Rough broken land	13	(1/)	--	VIIs-3	30	Shale Breaks	33	5	38
Ro	Rough gullied land	13	(1/)	--	VIIIe-3	30	(2/)	--	5	38
Sa	Sandy alluvial land	13	(1/)	--	VIw-1	29	Overflow	34	4	38
SkD	Slickspot-Kutch complex, 3 to 9 percent slopes	14	---	--	-----	--	--------	--	--	--
	Slickspot	--	(1/)	--	VIe-7	28	Salt Flats	34	5	38
	Kutch	--	(1/)	--	VIe-7	28	Clayey Plains	33	5	38
SkD3	Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded	14	---	--	-----	--	-----------	--	--	--
	Slickspot	--	(1/)	--	VIIe-2	29	Salt Flats	34	5	38
	Kutch	--	(1/)	--	VIIe-2	29	Clayey Plains	33	5	38
SmB	Stoneham loam, 1 to 3 percent slopes	14	IIIc-1	23	IVe-2	25	Loamy Plains	33	1	37

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Climatic zone B	Page	Capability unit: Climatic zone C	Page	Range site: Name	Page	Windbreak group: Group	Page
SmC	Stoneham loam, 3 to 5 percent slopes	14	IIIe-1	24	IVe-3	26	Loamy Plains	33	1	37
SnC	Stoneham sandy loam, 1 to 5 percent slopes	14	(1/)	--	IVe-6	26	Sandy Plains	32	3	38
SnE	Stoneham sandy loam, 5 to 18 percent slopes	15	(1/)	--	VIe-1	27	Sandy Plains	32	3	38
StC2	Stoneham complex, 1 to 5 percent slopes, eroded	15	(1/)	--	VIe-2	27	Sandy Plains	32	3	38
TaE	Terry fine sandy loam, 5 to 20 percent slopes	15	(1/)	--	VIe-1	27	Sandy Plains	32	3	38
Tc	Terry-Lismas complex	15	---	--	-----	--	-----------	--	--	--
	Terry	--	(1/)	--	VIs-3	29	Sandstone Breaks	34	3	38
	Lismas	--	(1/)	--	VIs-3	29	Shale Breaks	33	5	38
Tc3	Terry-Lismas complex, severely eroded	15	---	--	-----	--	-----------	--	--	--
	Terry	--	(1/)	--	VIIe-3	29	Sandstone Breaks	34	5	38
	Lismas	--	(1/)	--	VIIe-3	29	Shale Breaks	33	5	38
TeE	Terry-Vebar-Tullock complex, 5 to 25 percent slopes	15	---	--	-----	--	-----------	--	--	--
	Terry	--	(1/)	--	VIe-10	28	Sandy Plains	32	2	38
	Vebar	--	(1/)	--	VIe-10	28	Deep Sand	31	2	38
	Tullock	--	(1/)	--	VIe-10	28	Sandstone Breaks	34	2	38
TkB	Truckton sandy loam, 1 to 3 percent slopes	16	(1/)	--	IVe-5	26	Sandy Grassland	34	3	38
TkC	Truckton sandy loam, 3 to 5 percent slopes	16	(1/)	--	VIe-9	28	Sandy Grassland	34	3	38
TkE	Truckton sandy loam, 5 to 20 percent slopes	16	(1/)	--	VIe-9	28	Sandy Grassland	34	3	38
TrE2	Truckton, Bresser and Blakeland soils, 5 to 20 percent slopes, eroded	16	(1/)	--	VIe-9	28	Sandy Grassland	34	3	38
UaC	Ulm loam, 1 to 5 percent slopes	17	(1/)	--	IVe-3	26	Loamy Plains	33	1	37
UaD	Ulm loam, 5 to 12 percent slopes	17	(1/)	--	VIe-4	27	Loamy Slopes	33	1	37
UaD3	Ulm loam, 5 to 12 percent slopes, severely eroded	17	(1/)	--	VIIe-1	29	Loamy Slopes	33	1	37
UbD	Ulm-Beckton complex, 3 to 9 percent slopes	17	---	--	-----	--	-----------	--	--	--
	Ulm	--	(1/)	--	VIe-7	28	Loamy Plains	33	1	37
	Beckton	--	(1/)	--	VIe-7	28	Salt Flats	34	5	38
UbE3	Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded	17	(1/)	--	VIIe-1	29	Loamy Slopes	33	5	38
VbC	Vebar loamy fine sand, 3 to 5 percent slopes	17	(1/)	--	VIe-8	28	Deep Sand	31	2	38
VbE	Vebar loamy fine sand, 5 to 20 percent slopes	17	(1/)	--	VIe-8	28	Deep Sand	31	2	38
WaA	Weld loam, 0 to 1 percent slopes	18	IIIc-1	23	IVe-2	25	Loamy Plains	33	1	37
WaB	Weld loam, 1 to 3 percent slopes	18	IIIc-1	23	IVe-2	25	Loamy Plains	33	1	37
WaC	Weld loam, 3 to 5 percent slopes	18	IIIe-1	24	IVe-3	26	Loamy Plains	33	1	37
Wb	Wet alluvial land	19	(1/)	--	Vw-1	27	Sandy Meadow	34	4	38
WcC	Wiley and Colby soils, 3 to 5 percent slopes	19	(1/)	--	VIe-3	27	Loamy Plains	33	1	37
WcE	Wiley and Colby soils, 5 to 18 percent slopes	19	(1/)	--	VIe-4	27	Loamy Slopes	33	1	37
Yg	Yoder gravelly sandy loam	20	(1/)	--	VIs-3	29	Gravelly Outwash	35	3	38
Yt	Yoder-Truckton-Lismas complex	20	---	--	-----	--	------------	--	--	--
	Yoder	--	(1/)	--	VIs-3	29	Gravelly Outwash	35	3	38
	Truckton	--	(1/)	--	VIs-3	29	Sandy Grassland	34	3	38
	Lismas	--	(1/)	--	VIs-3	29	Shale Breaks	33	5	38

1/Not in climatic zone B.

2/Not in a range site

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
COLORADO AGRICULTURAL
EXPERIMENT STATION

N

GENERAL SOIL MAP
ELBERT COUNTY, COLORADO, EASTERN PART

Scale 1:253 440
1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

1 Weld-Baca-Wiley association: Deep, nearly level to sloping, loamy soils of the uplands

2 Bresser-Truckton-Blakeland association: Deep and moderately deep, gently sloping to moderately steep, sandy soils of the uplands

3 Christianburg-Nunn-Arvada association: Deep and moderately deep, nearly level to gently sloping soils, mainly on stream terraces and alluvial fans

4 Platner-Ascalon-Stoneham association: Deep and moderately deep, very gently sloping to moderately steep soils of the uplands

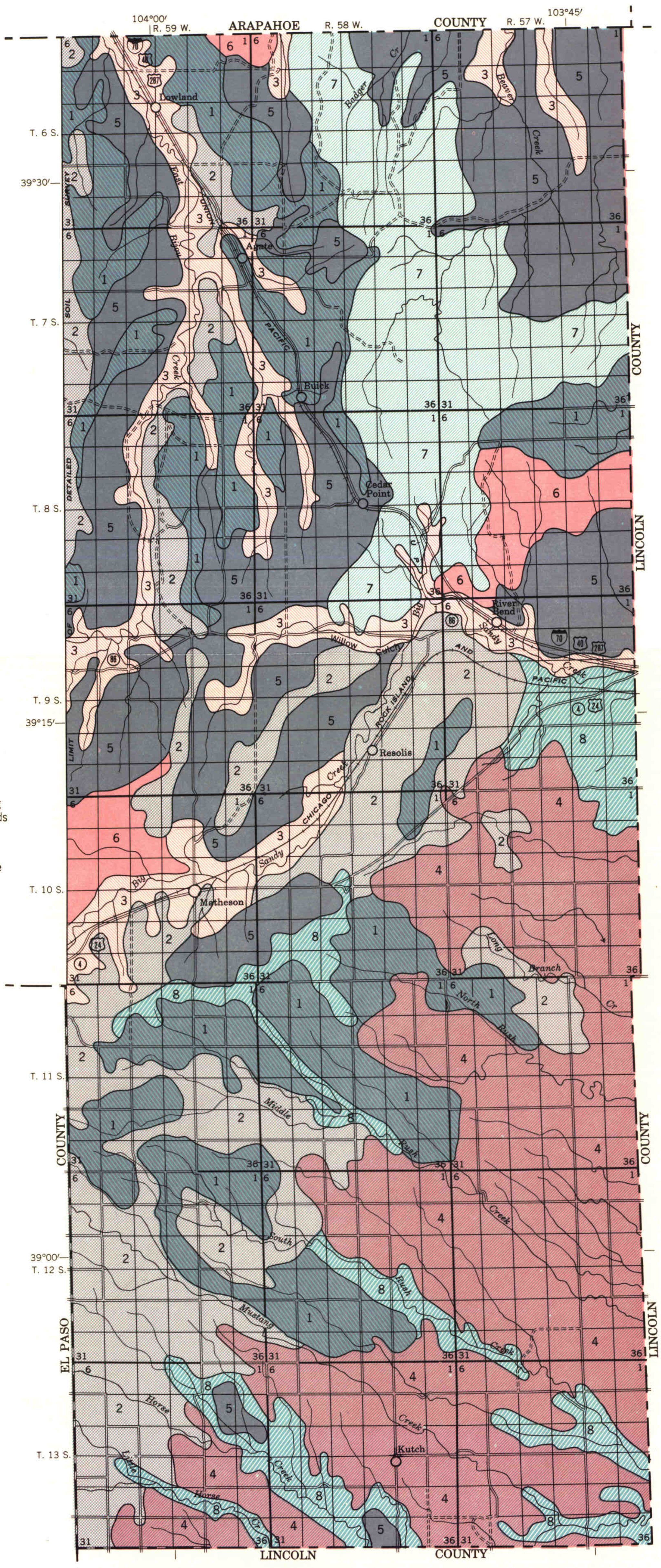
5 Renohill-Kutch association: Deep and moderately deep, gently sloping to steep soils of the uplands

6 Ulm-Midway association: Deep to shallow, sloping soils of the uplands

7 Vebar-Terry-Tullock association: Deep to shallow, rolling and sloping to steep, sandy and shaly soils of the uplands

8 Yoder-Blakeland-Lismas association: Shallow to deep, gravelly, sandy, and shaly soils along drainageways in the uplands

May 1965



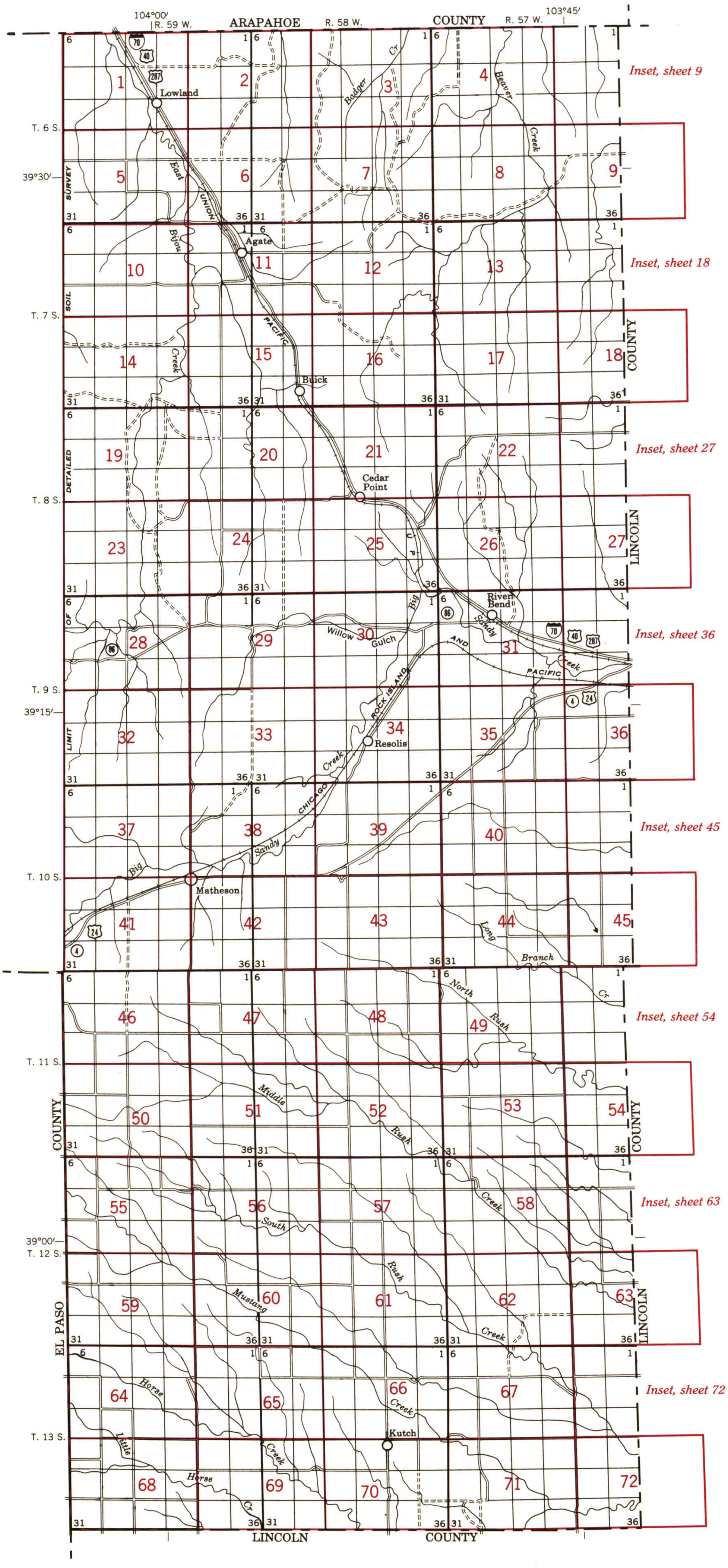
N

INDEX TO MAP SHEETS

ELBERT COUNTY, COLORADO, EASTERN PART

Scale 1:253 440

1 0 1 2 3 4 Miles



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Some symbols without a slope letter are those of nearly level soils or land types, but some are for soils or land types that have considerable range in slope. A final number, 2 or 3, in a symbol means that a soil is eroded, or severely eroded.

SYMBOL	NAME
AaA	Arvada loam, 0 to 3 percent slopes
AcB2	Arvada complex, 0 to 3 percent slopes, eroded
AnB	Ascalon sandy loam, 1 to 3 percent slopes
AnC	Ascalon sandy loam, 3 to 5 percent slopes
AnD	Ascalon sandy loam, 5 to 9 percent slopes
AnE	Ascalon sandy loam, 9 to 15 percent slopes
ApB2	Ascalon complex, 1 to 3 percent slopes, eroded
ApC2	Ascalon complex, 3 to 5 percent slopes, eroded
BaC	Baca loam, 3 to 5 percent slopes
BaE	Baca loam, 5 to 15 percent slopes
BcE2	Baca complex, 5 to 15 percent slopes, eroded
Bd	Badlands
Be	Blakeland loamy sand
Bk	Breaks-Alluvial land complex
BmB	Bresser sandy loam, 1 to 3 percent slopes
BmC	Bresser sandy loam, 3 to 5 percent slopes
BmD	Bresser sandy loam, 5 to 9 percent slopes
BmE	Bresser sandy loam, 9 to 15 percent slopes
BrC2	Bresser complex, 3 to 5 percent slopes, eroded
BtD	Bresser-Truckton-Blakeland complex, 3 to 9 percent slopes
CbA	Christianburg clay, 0 to 3 percent slopes
CbB3	Christianburg clay, 0 to 3 percent slopes, severely eroded
CbC	Christianburg clay, 3 to 5 percent slopes
ChA	Christianburg sandy loam, 0 to 3 percent slopes
EaA	Eastonville loamy sand, 0 to 3 percent slopes
EaC	Eastonville loamy sand, 3 to 5 percent slopes
FcA	Fort Collins loam, 0 to 3 percent slopes
Gr	Gravelly land
KcC	Kutch clay, 1 to 5 percent slopes
KcE	Kutch clay, 5 to 15 percent slopes
KcE3	Kutch clay, 5 to 15 percent slopes, severely eroded
Lc	Lismas clay
Lc2	Lismas clay, eroded
Lo	Loamy alluvial land
Mb	Midway-Bainville complex
Mb2	Midway-Bainville complex, eroded
Mu	Midway-Ulm complex
Mu3	Midway-Ulm complex, severely eroded
NmA	Nunn loam, 0 to 3 percent slopes
NmC3	Nunn loam, 3 to 5 percent slopes, severely eroded
NnA	Nunn sandy loam, 0 to 3 percent slopes
PmA	Platner loam, 0 to 1 percent slopes
PmB	Platner loam, 1 to 3 percent slopes
PmC	Platner loam, 3 to 5 percent slopes
PmD	Platner loam, 5 to 9 percent slopes
PsB	Platner-Ascalon sandy loams, 0 to 3 percent slopes
PsC	Platner-Ascalon sandy loams, 3 to 5 percent slopes
Rc	Renohill clay loam
ReE2	Renohill complex, 3 to 15 percent slopes, eroded
Rh	Riverwash
Rn	Rough broken land
Ro	Rough gullied land
Sa	Sandy alluvial land
SkD	Slickspot-Kutch complex, 3 to 9 percent slopes
SkD3	Slickspot-Kutch complex, 3 to 9 percent slopes, severely eroded
SmB	Stoneham loam, 1 to 3 percent slopes
SmC	Stoneham loam, 3 to 5 percent slopes
SnC	Stoneham sandy loam, 1 to 5 percent slopes
SnE	Stoneham sandy loam, 5 to 18 percent slopes
StC2	Stoneham complex, 1 to 5 percent slopes, eroded
TaE	Terry fine sandy loam, 5 to 20 percent slopes
Tc	Terry-Lismas complex
Tc3	Terry-Lismas complex, severely eroded
TeE	Terry-Vebar-Tullock complex, 5 to 25 percent slopes
TkB	Truckton sandy loam, 1 to 3 percent slopes
TkC	Truckton sandy loam, 3 to 5 percent slopes
TkE	Truckton sandy loam, 5 to 20 percent slopes
TrE2	Truckton, Bresser, and Blakeland soils, 5 to 20 percent slopes, eroded
UaC	Ulm loam, 1 to 5 percent slopes
UaD	Ulm loam, 5 to 12 percent slopes,
UaD3	Ulm loam, 5 to 12 percent slopes, severely eroded
UbD	Ulm-Beckton complex, 3 to 9 percent slopes
UbE3	Ulm-Beckton complex, 9 to 15 percent slopes, severely eroded
VbC	Vebar loamy fine sand, 3 to 5 percent slopes
VbE	Vebar loamy fine sand, 5 to 20 percent slopes
WaA	Weld loam, 0 to 1 percent slopes
WaB	Weld loam, 1 to 3 percent slopes
WaC	Weld loam, 3 to 5 percent slopes
Wb	Wet alluvial land
WcC	Wiley and Colby soils, 3 to 5 percent slopes
WcE	Wiley and Colby soils, 5 to 18 percent slopes
Yg	Yoder gravelly sandy loam
Yt	Yoder-Truckton-Lismas complex

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church

Mines and Quarries

Mine dump

Pits, gravel or other

Cemeteries

Dams

Levees

Tanks

Oil wells

Windmills

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

Drainage ends

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

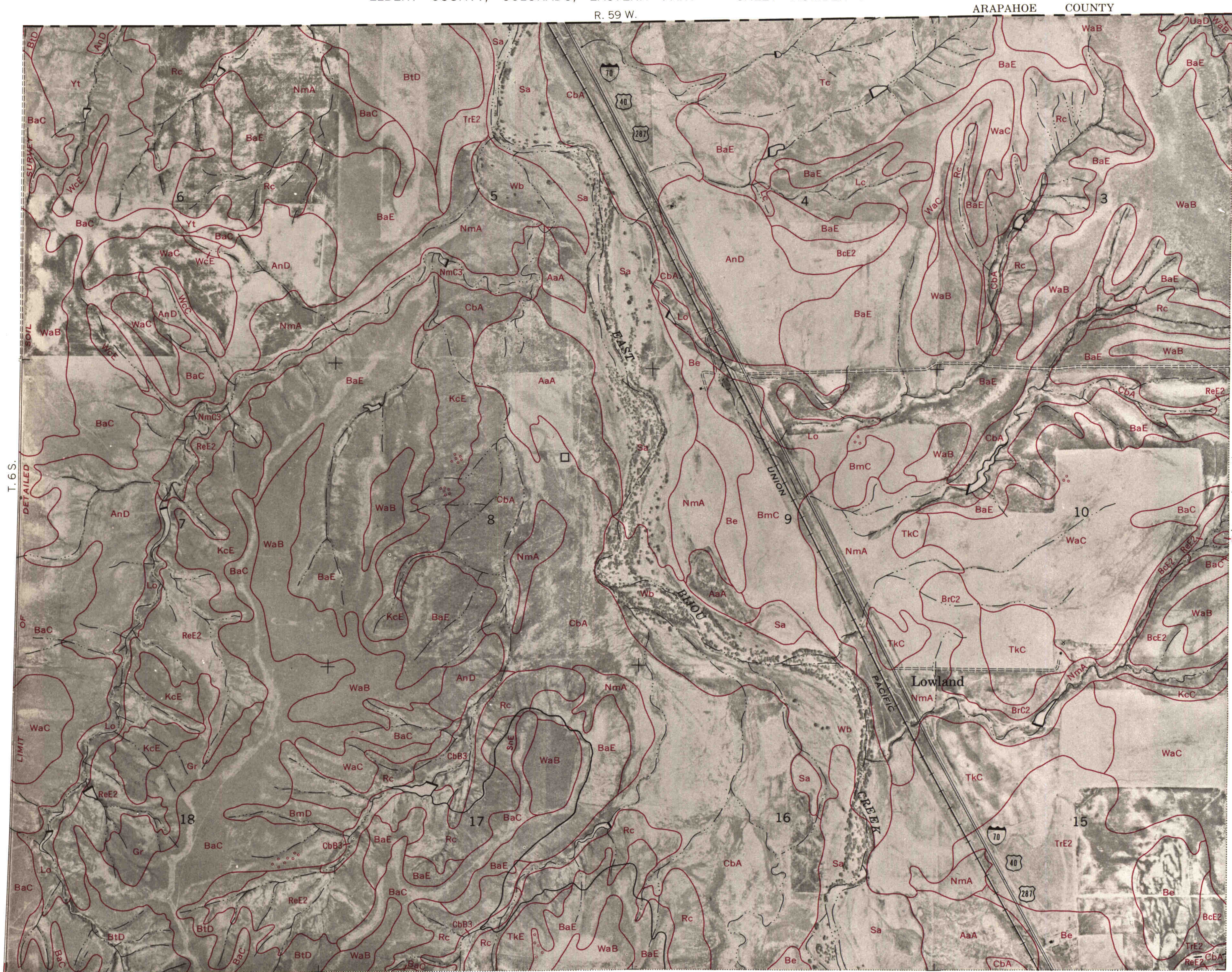
Depressions — Large, Small
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

Soil map constructed 1965 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on Colorado plane coordinate system, central zone, Lambert conformal conic projection. 1927 North American datum.

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 1

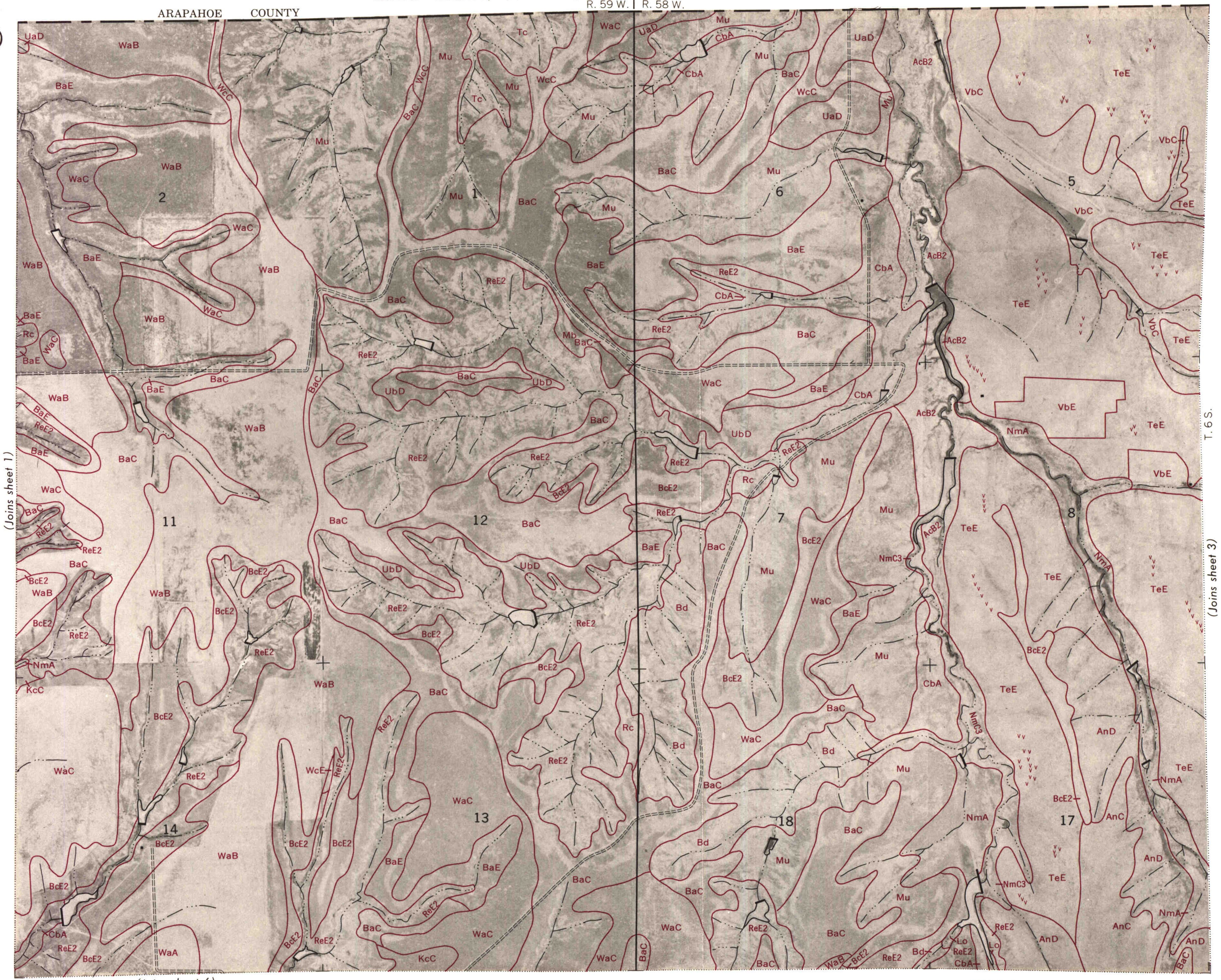


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 2



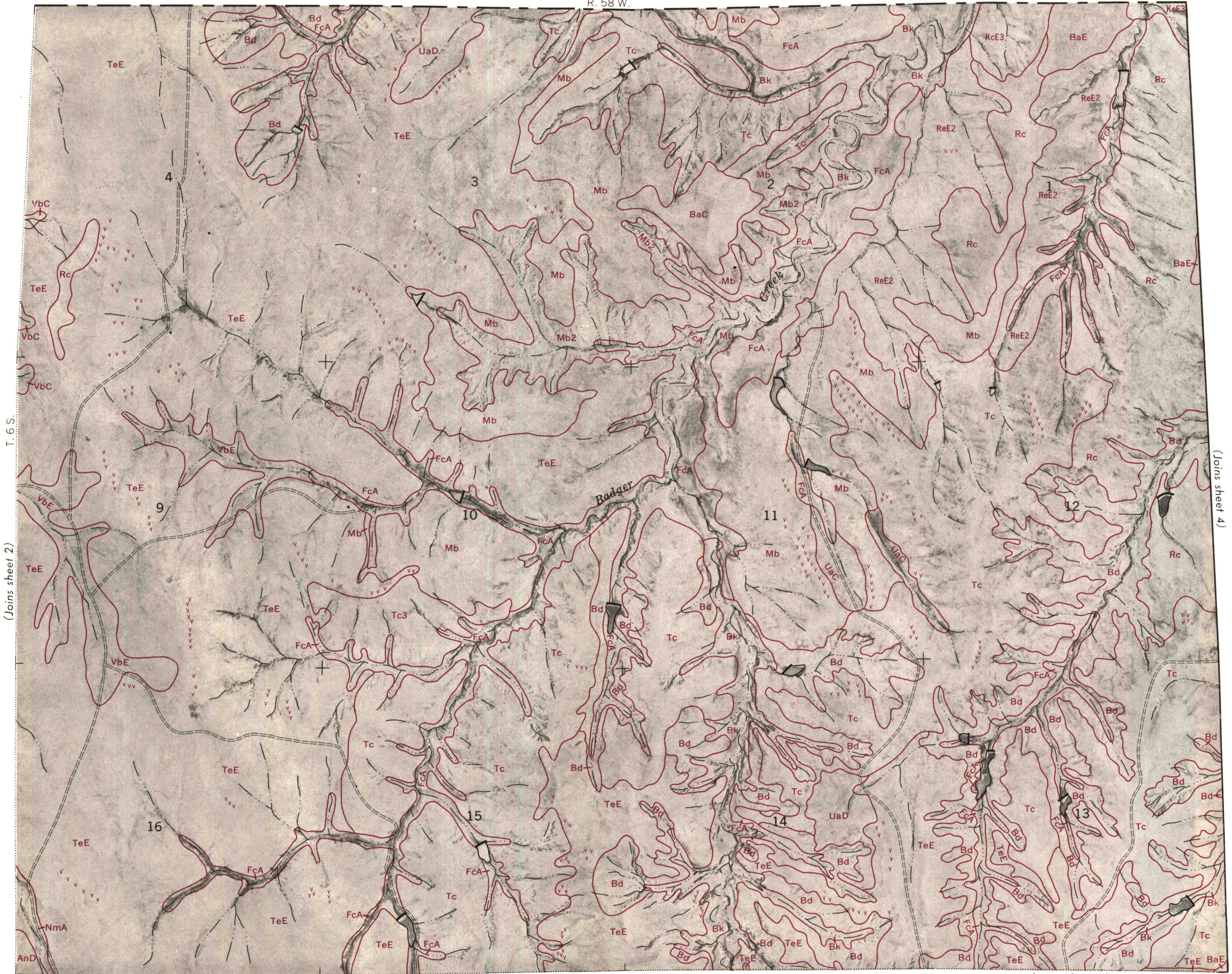
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 3

(3)

R. 58 W.

ARAPAHOE COUNTY



N

T. 6 S.

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 7)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


4
N
ARAPAHOE COUNTY
R. 57 W.
T. 6 S.
(Joins sheet 3)
(Joins inset, sheet 9)
BEAVER CREEK
(Joins sheet 8)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

6

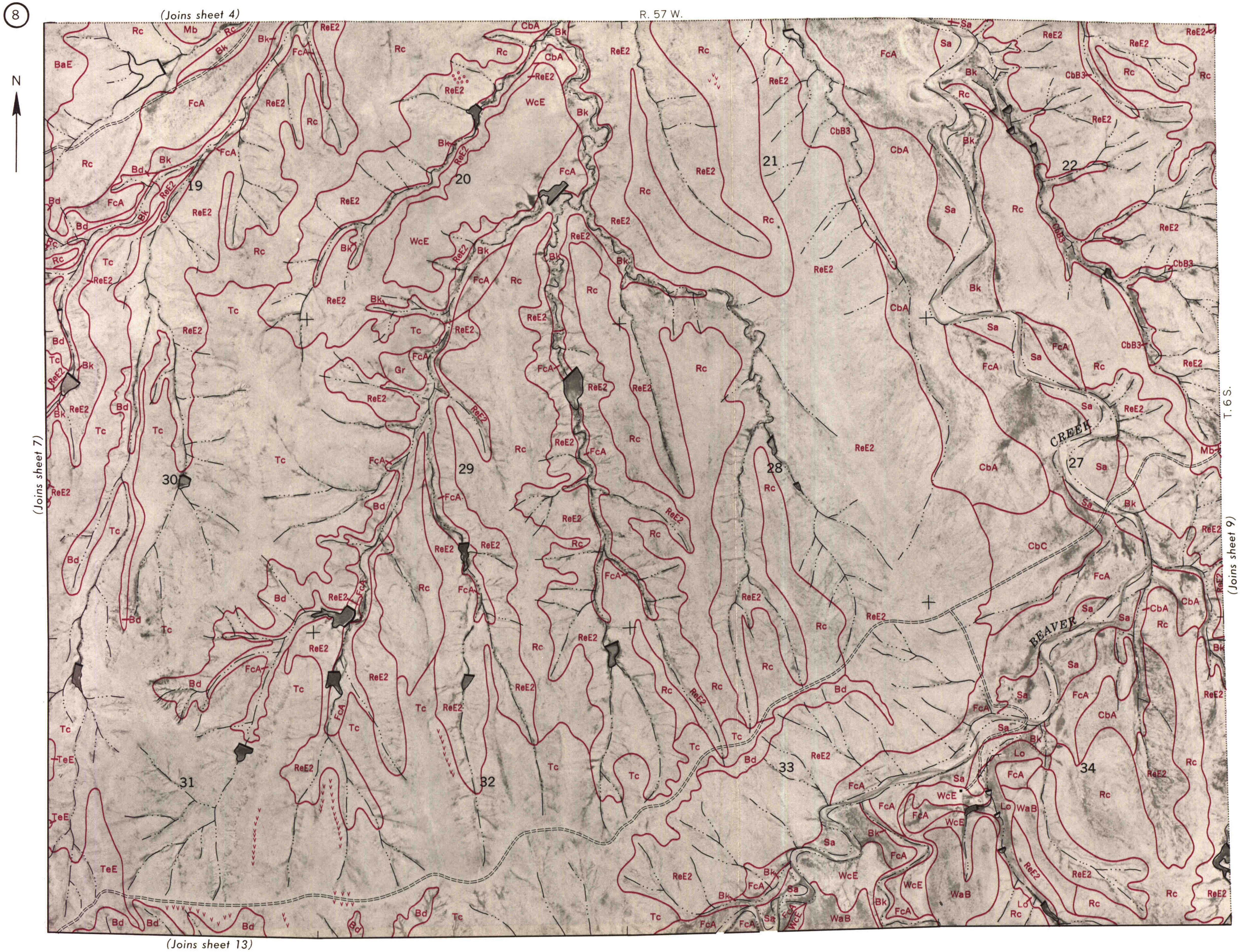
N

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

10

(Joins sheet 5)

R. 59 W.

(Joins sheet 14)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 12

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

14

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 15

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

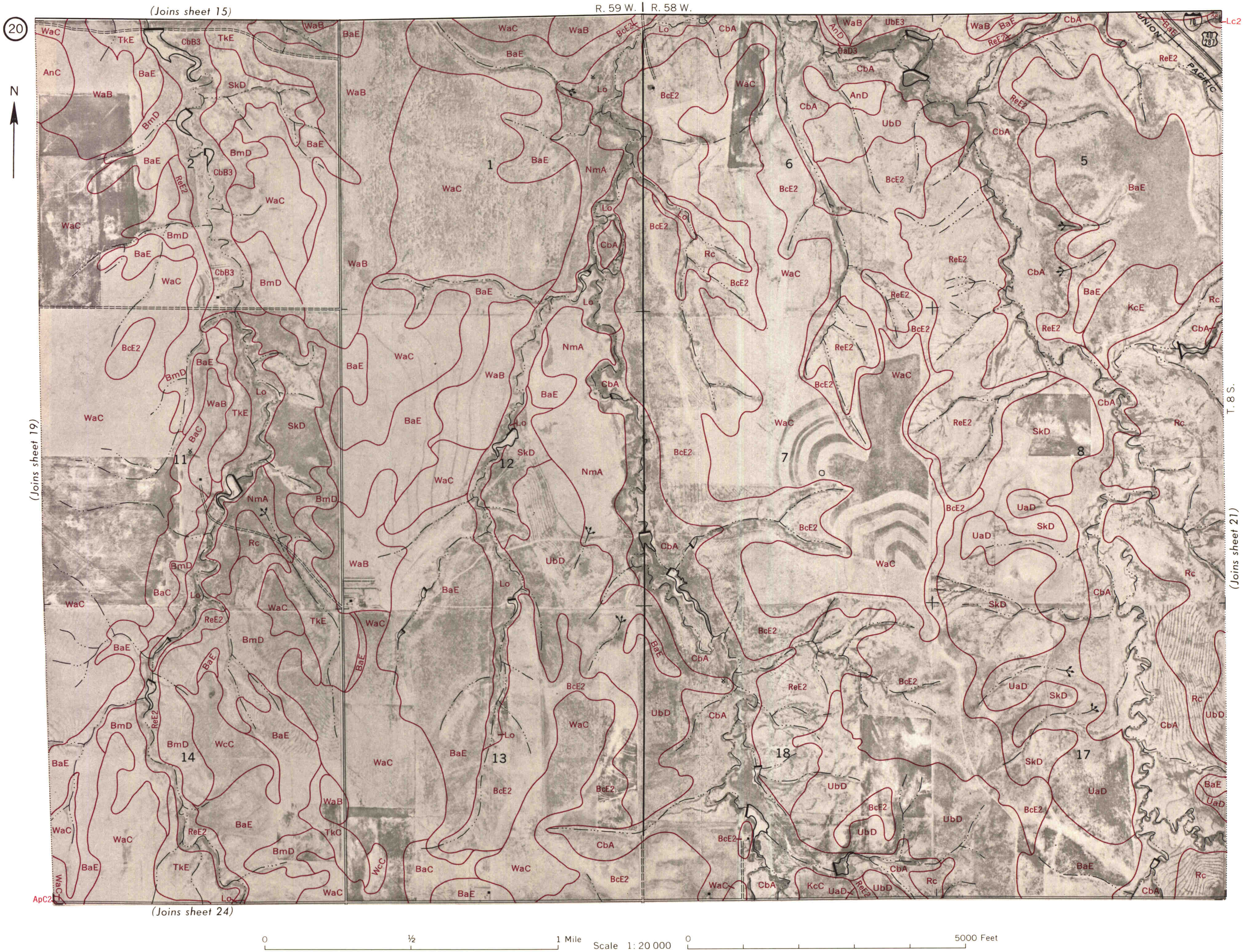
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

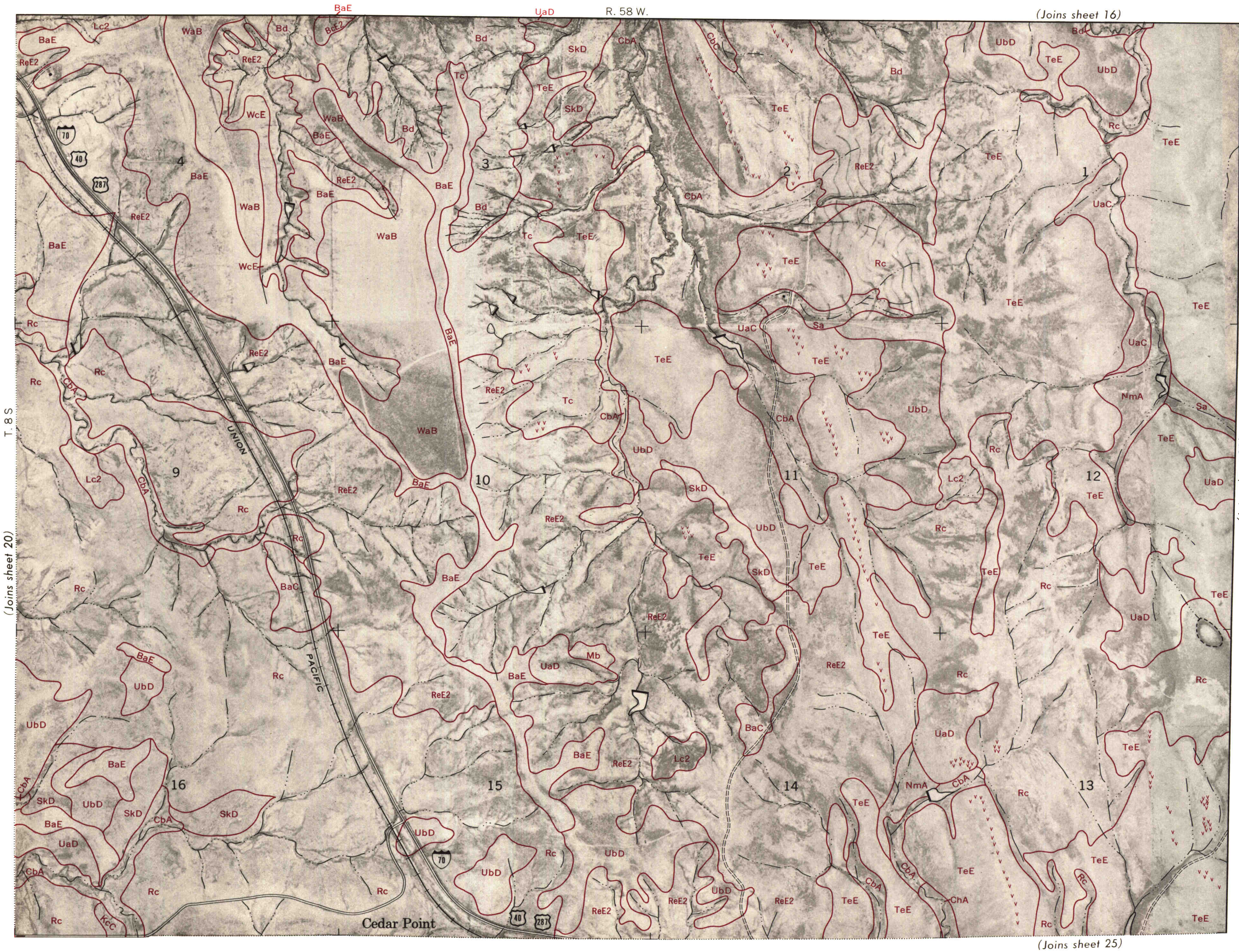
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 20



21



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

23

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

27

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

R. 59 W.

(Joins sheet 23)

(Joins sheet 29)

(Joins sheet 32)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 29

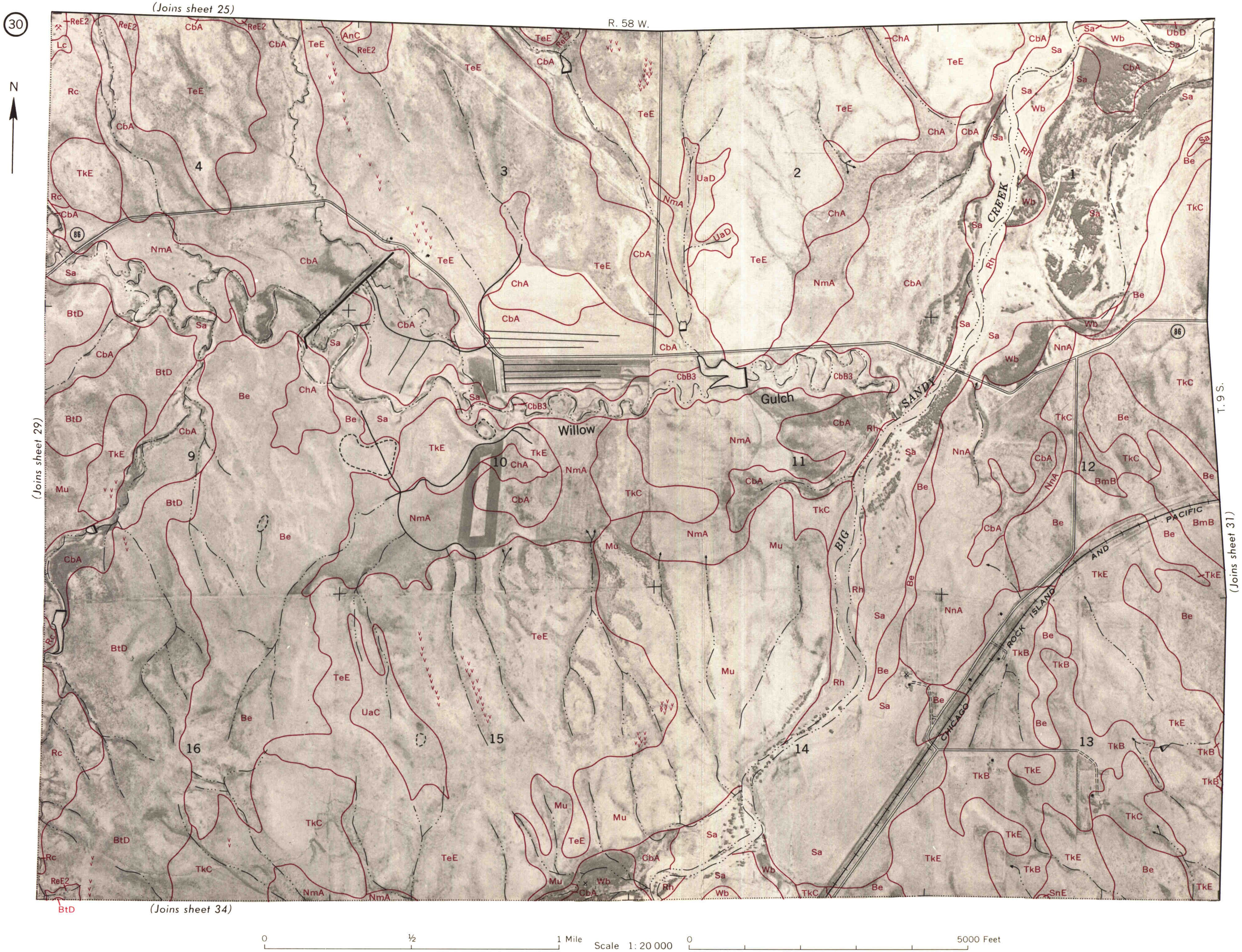
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1: 20 000

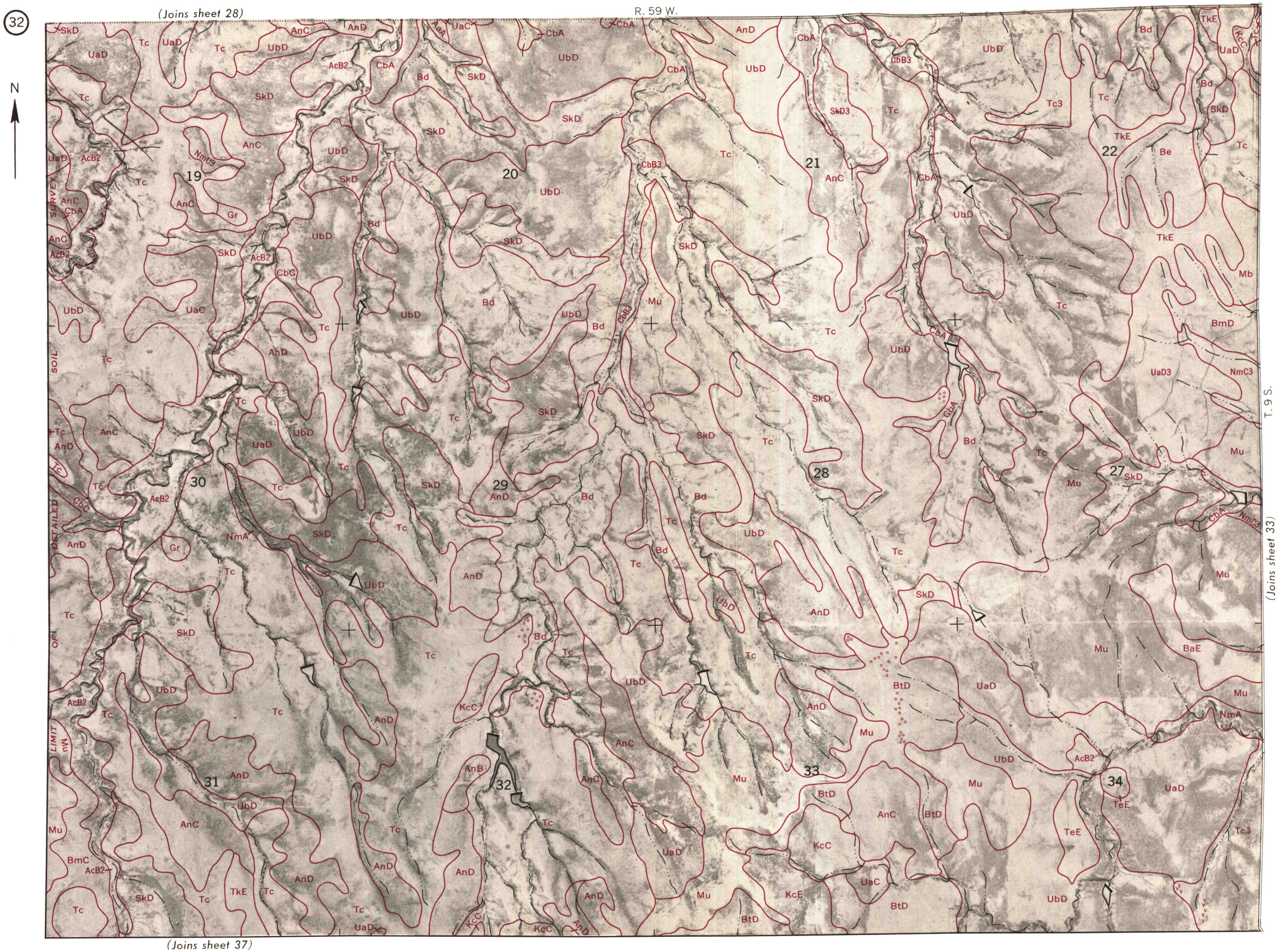
0 5000 Feet


30
(Joins sheet 25)
R. 58 W.
N
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 34)
T. 9 S.
Willow
Gulch
BIG SANDY CREEK
CHICAGO ROCK ISLAND AND PACIFIC
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

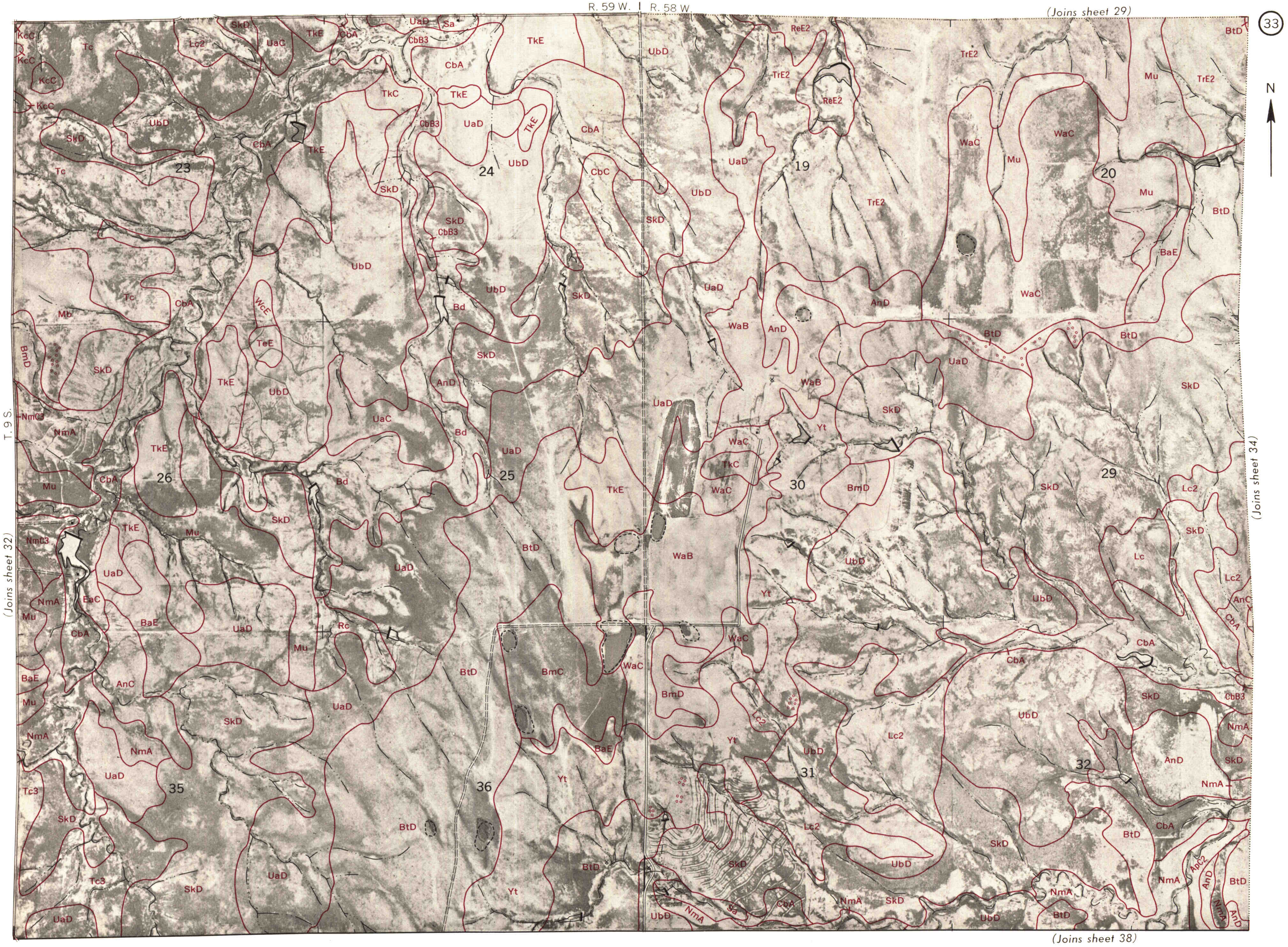
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



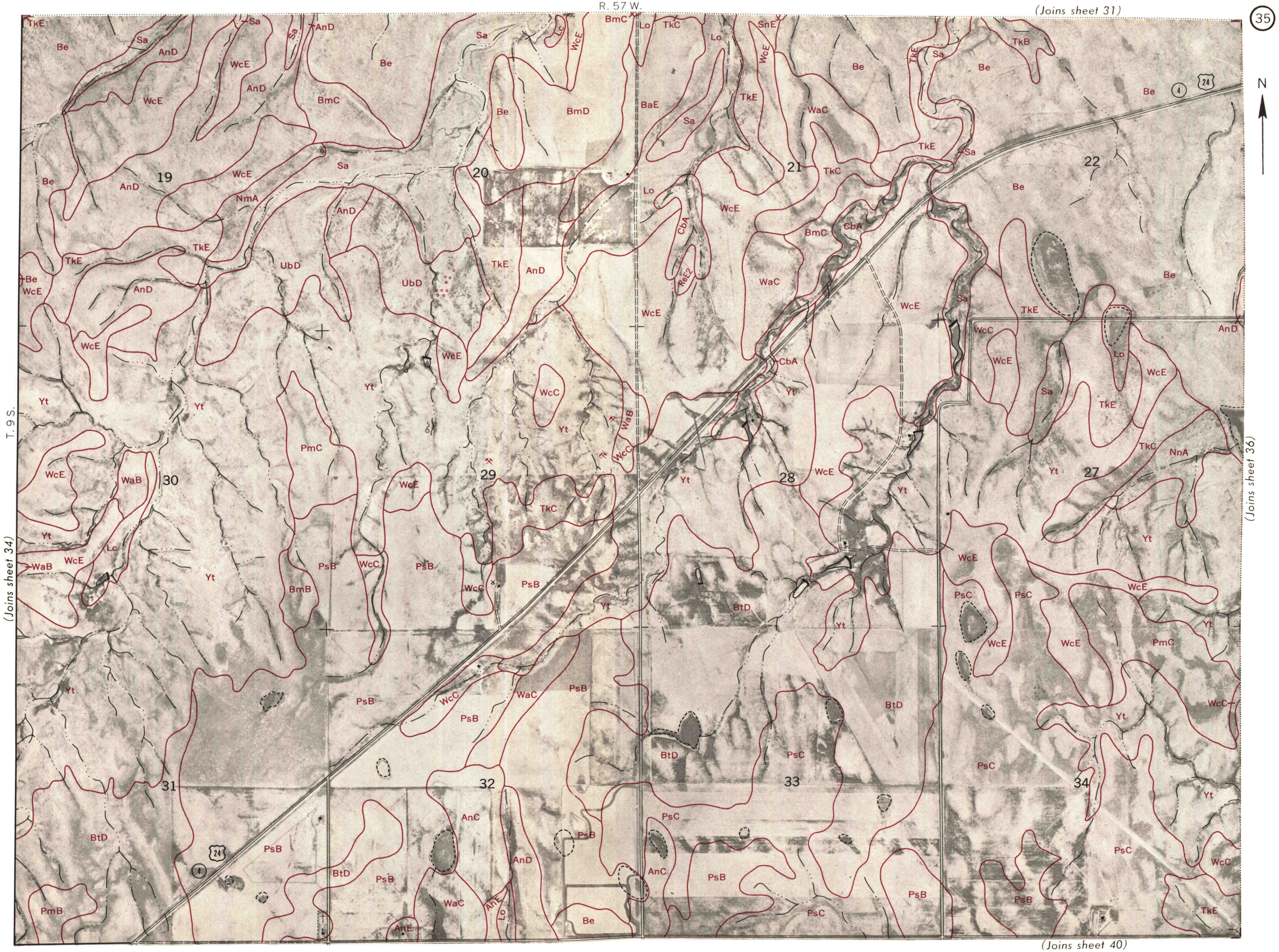
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

34

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

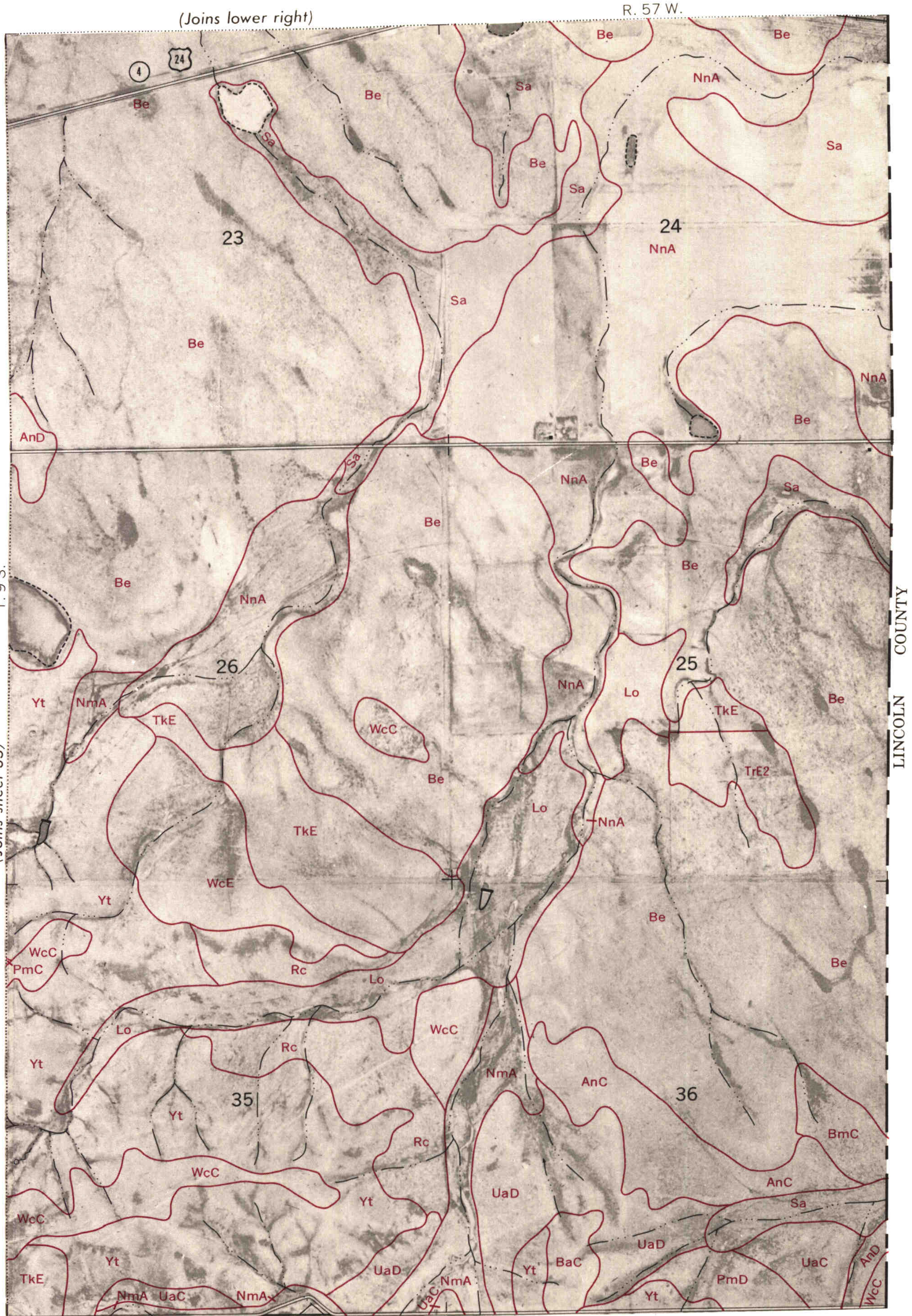


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

36



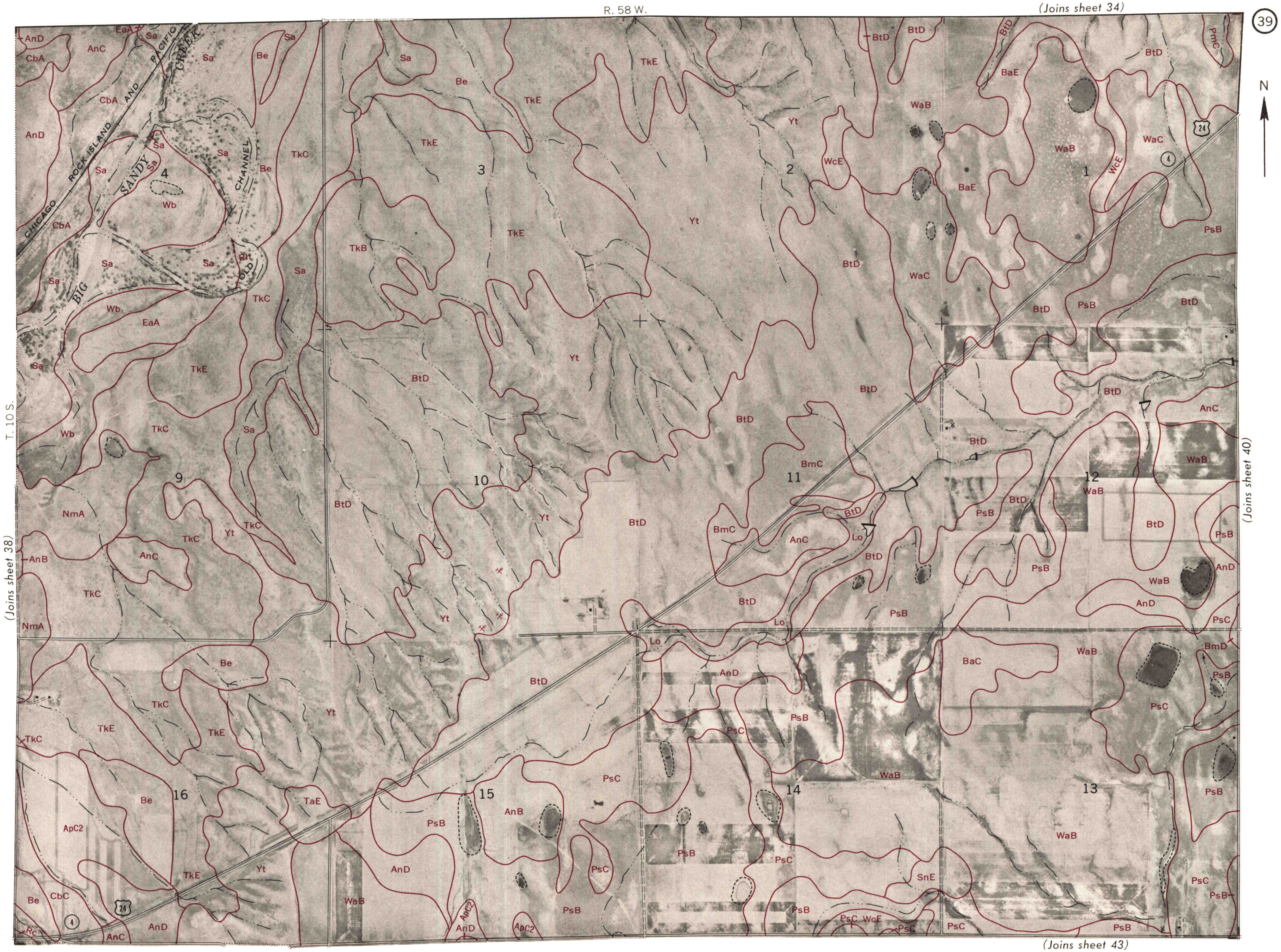
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


38
(Joins sheet 33)
R. 59 W. | R. 58 W.
N
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 42)
T. 10 S.
CHICAGO ROCK ISLAND AND PACIFIC
BIG SANDY CREEK
Matheson
24
4
Scale 1: 20 000
0
½
1 Mile
5000 Feet



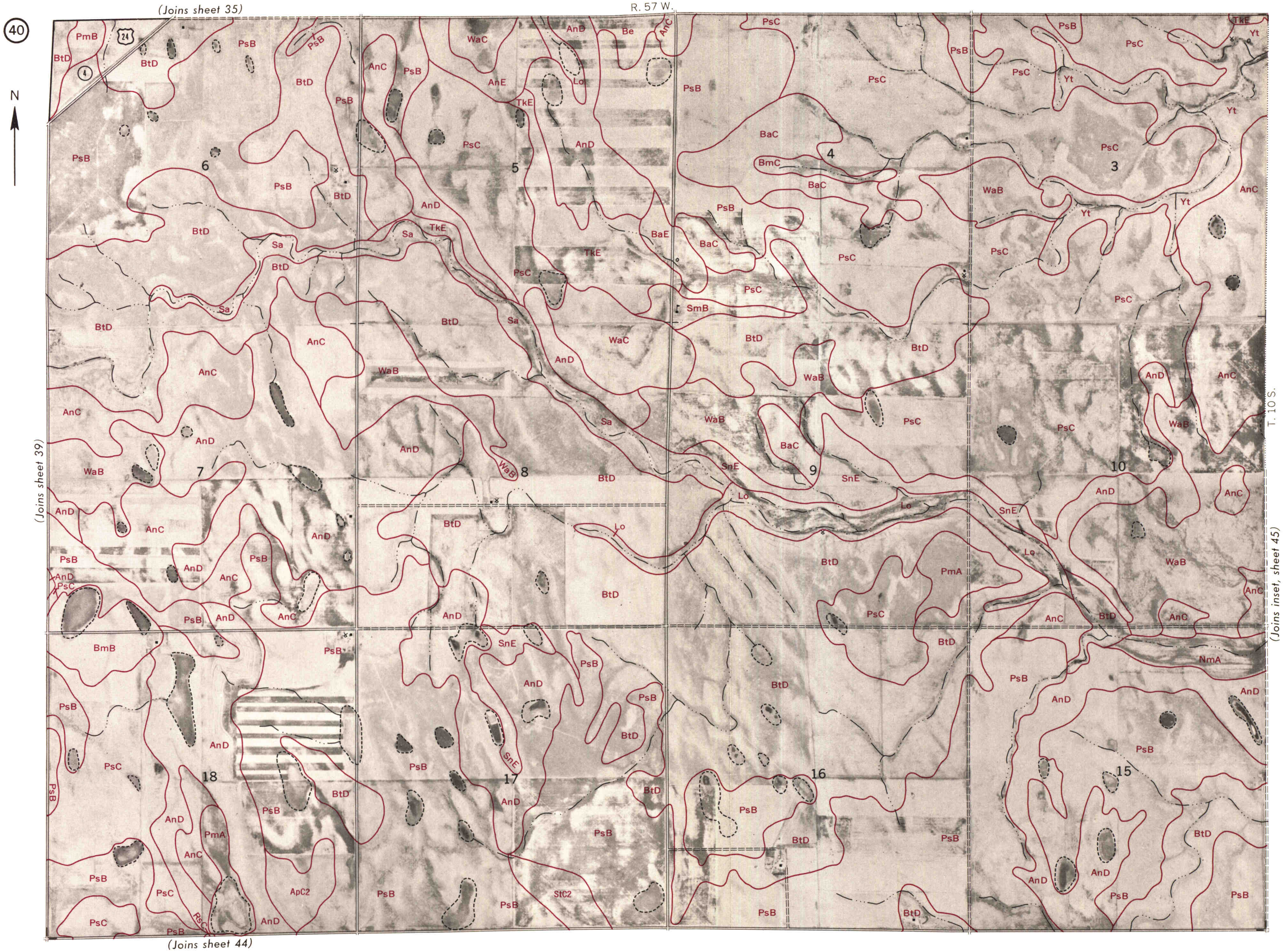
Scale 1: 20 000

0 ½ 1 Mile

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 41

R. 59 W.

(Joins sheet 37)

41

T. 10 S.

(Joins sheet 42)

(Joins sheet 46) | (47)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

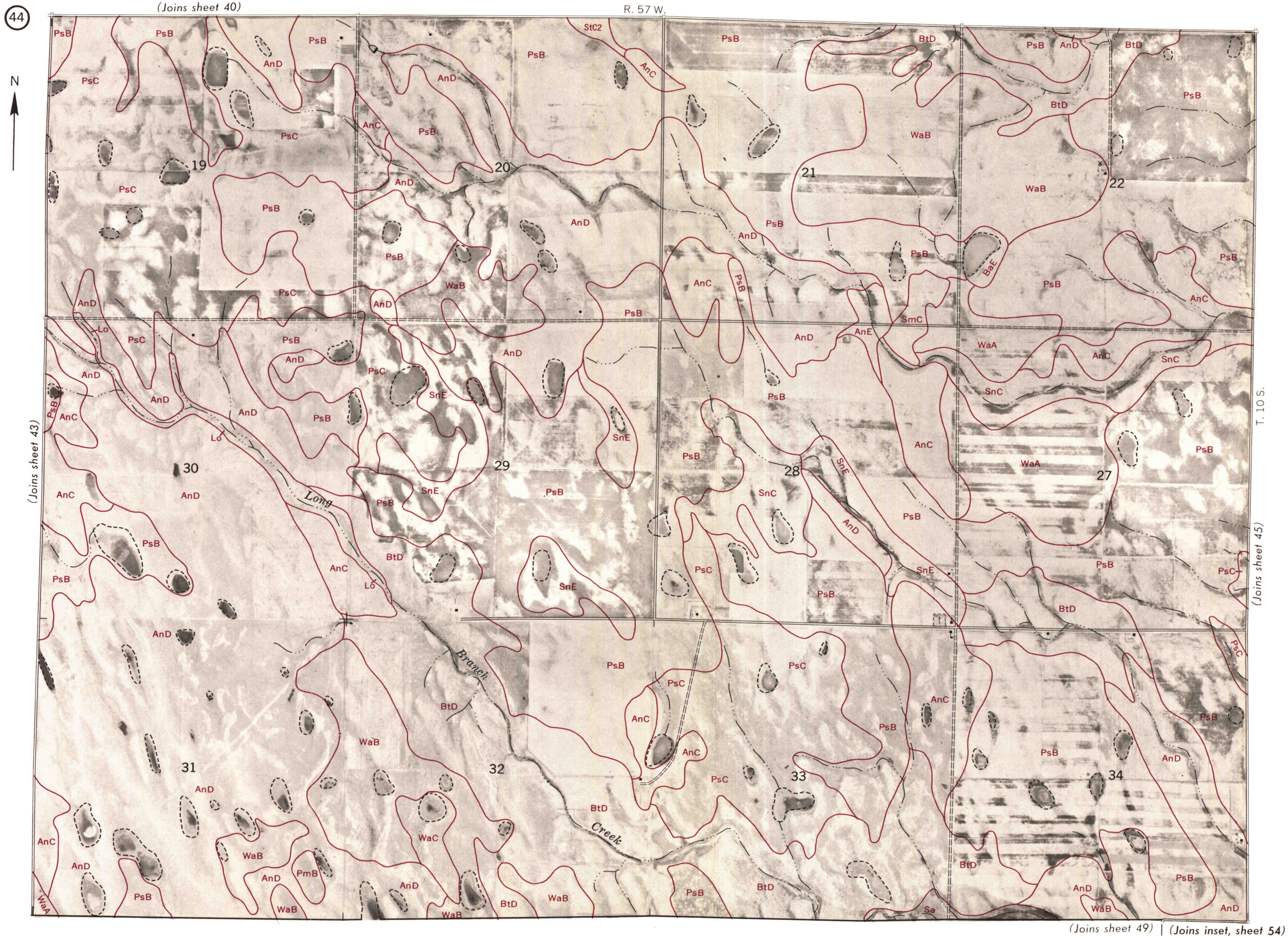
42

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



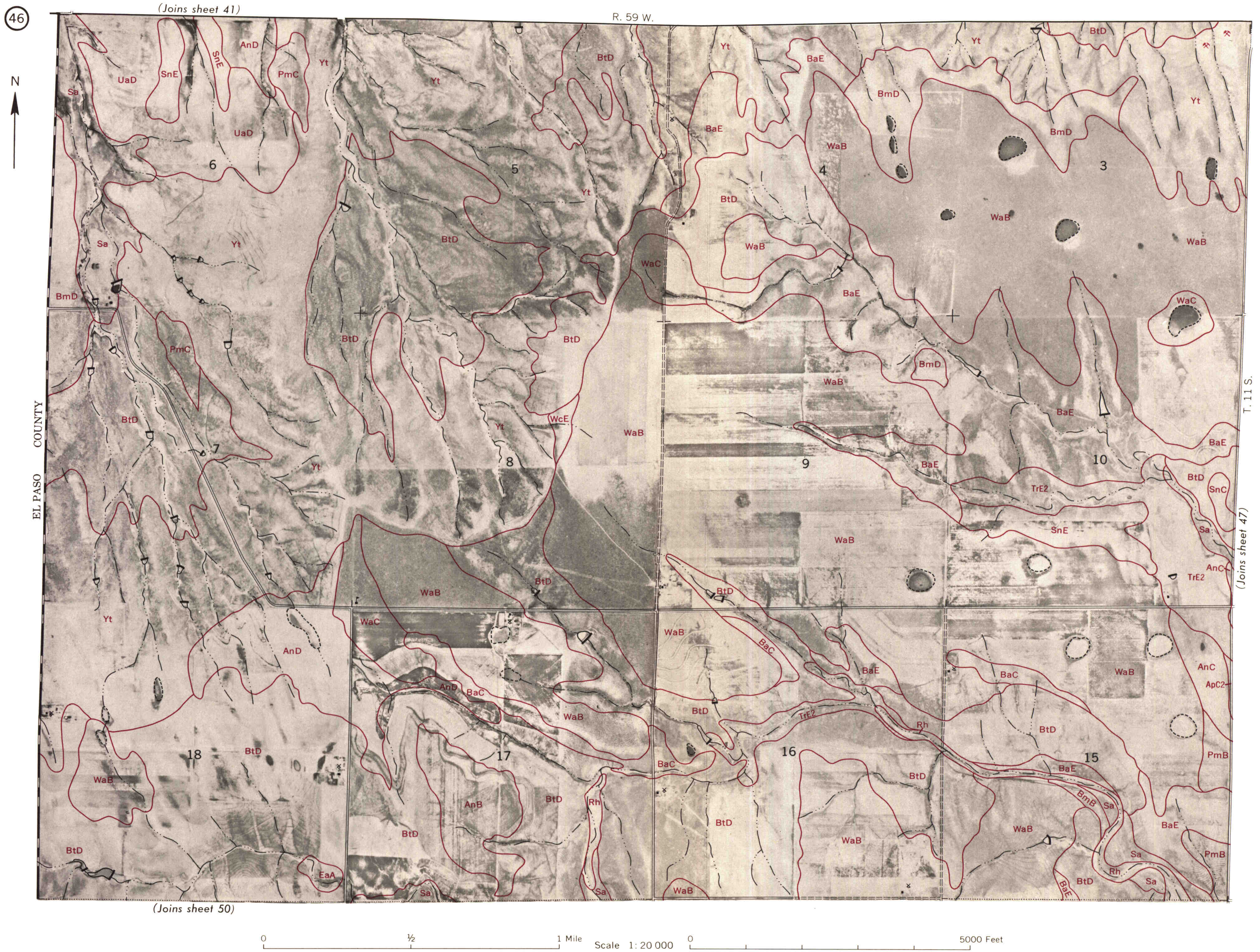
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(46)

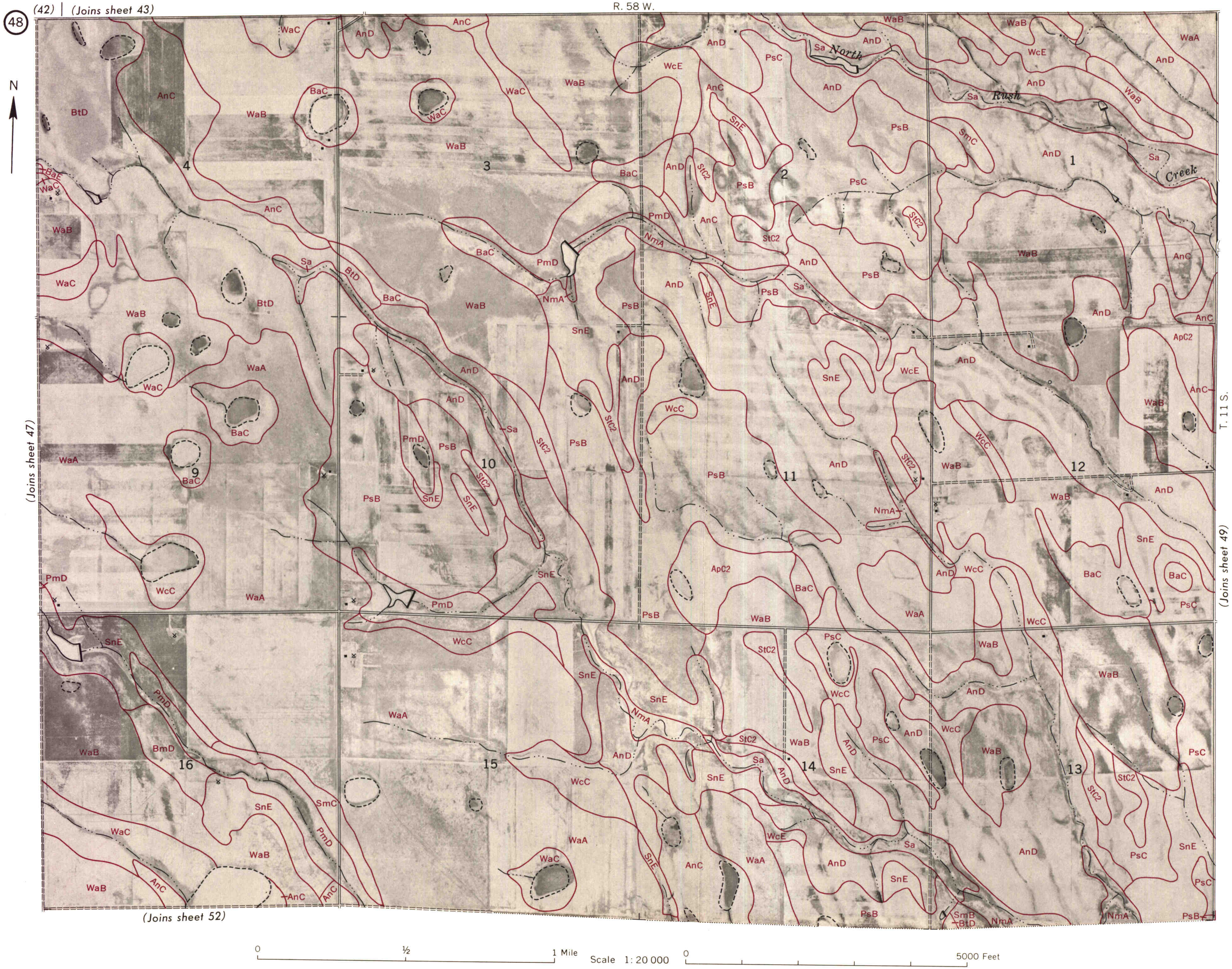


(Joins sheet 41)
R. 59 W.
T. 11 S.
EL PASO COUNTY
(Joins sheet 47)
(Joins sheet 50)
N
UaD
SnE
AnD
PmC
Yt
Sa
BtD
BaE
BmD
WaB
WaC
WcE
BaC
TrE2
SnC
AnC
ApC2
PmB
Rh
BmB
EaA
AnB
3
4
5
6
7
8
9
10
15
16
17
18
0
½
1 Mile
Scale 1:20 000
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


48
(42) | (Joins sheet 43)
R. 58 W.
N
T. 11 S.
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 52)
North Rush Creek
1
2
3
4
9
10
11
12
13
14
15
16
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 49

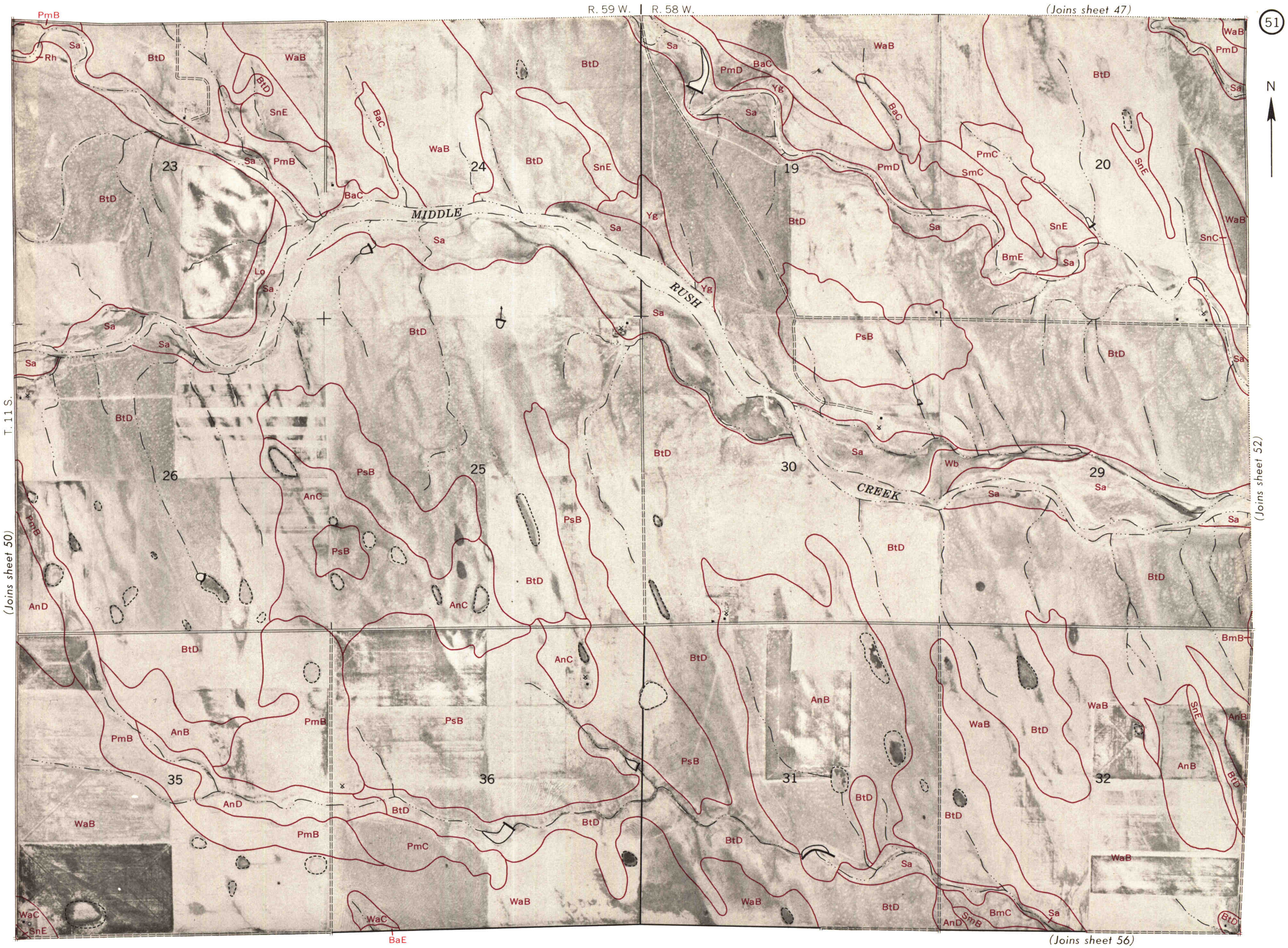
49

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

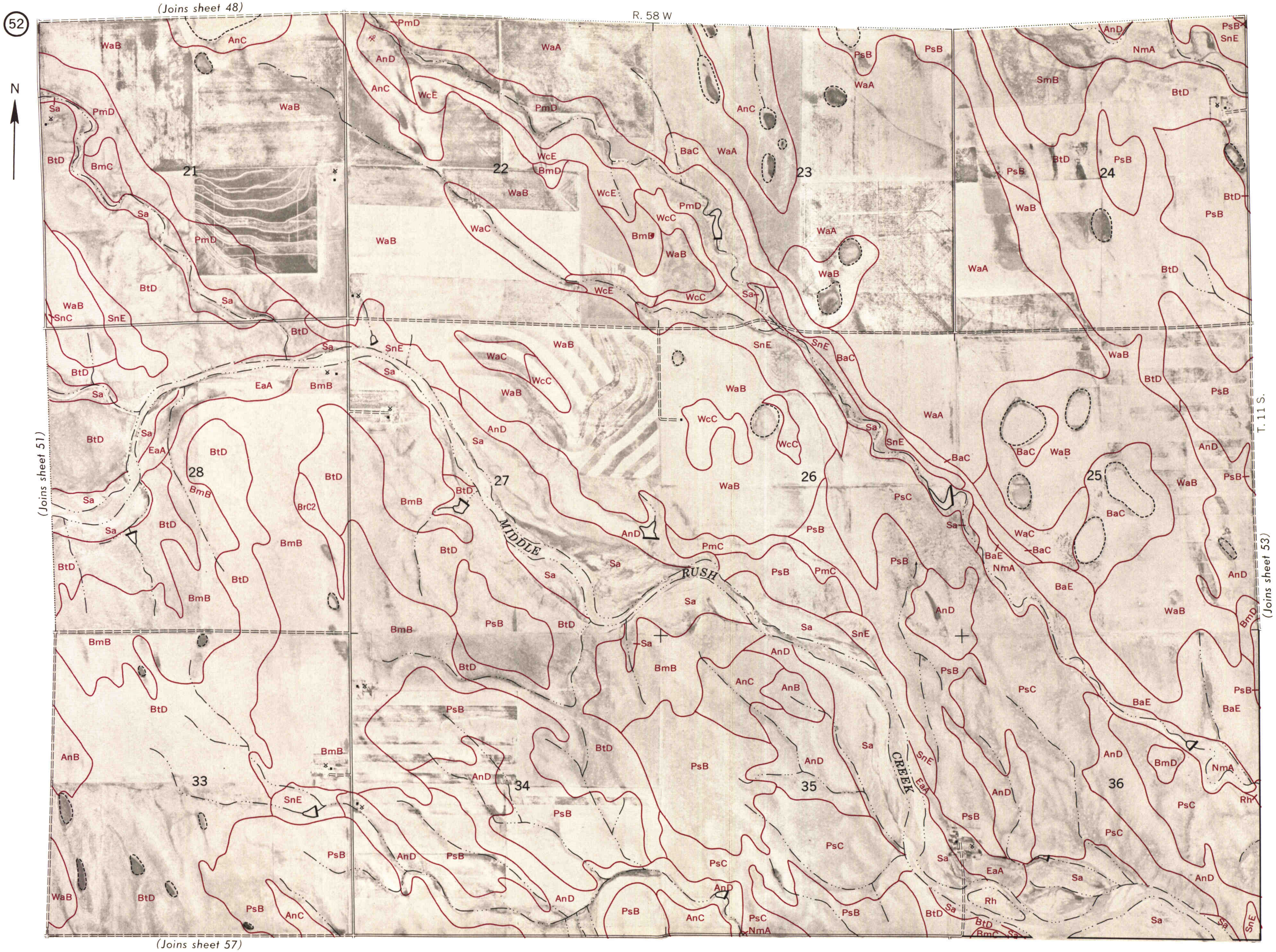

50
(Joins sheet 46)
R. 59 W.
N
EL PASO COUNTY
T. 11 S.
(Joins sheet 51)
(Joins sheet 55)
19
20
21
22
30
29
28
27
31
32
33
34
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



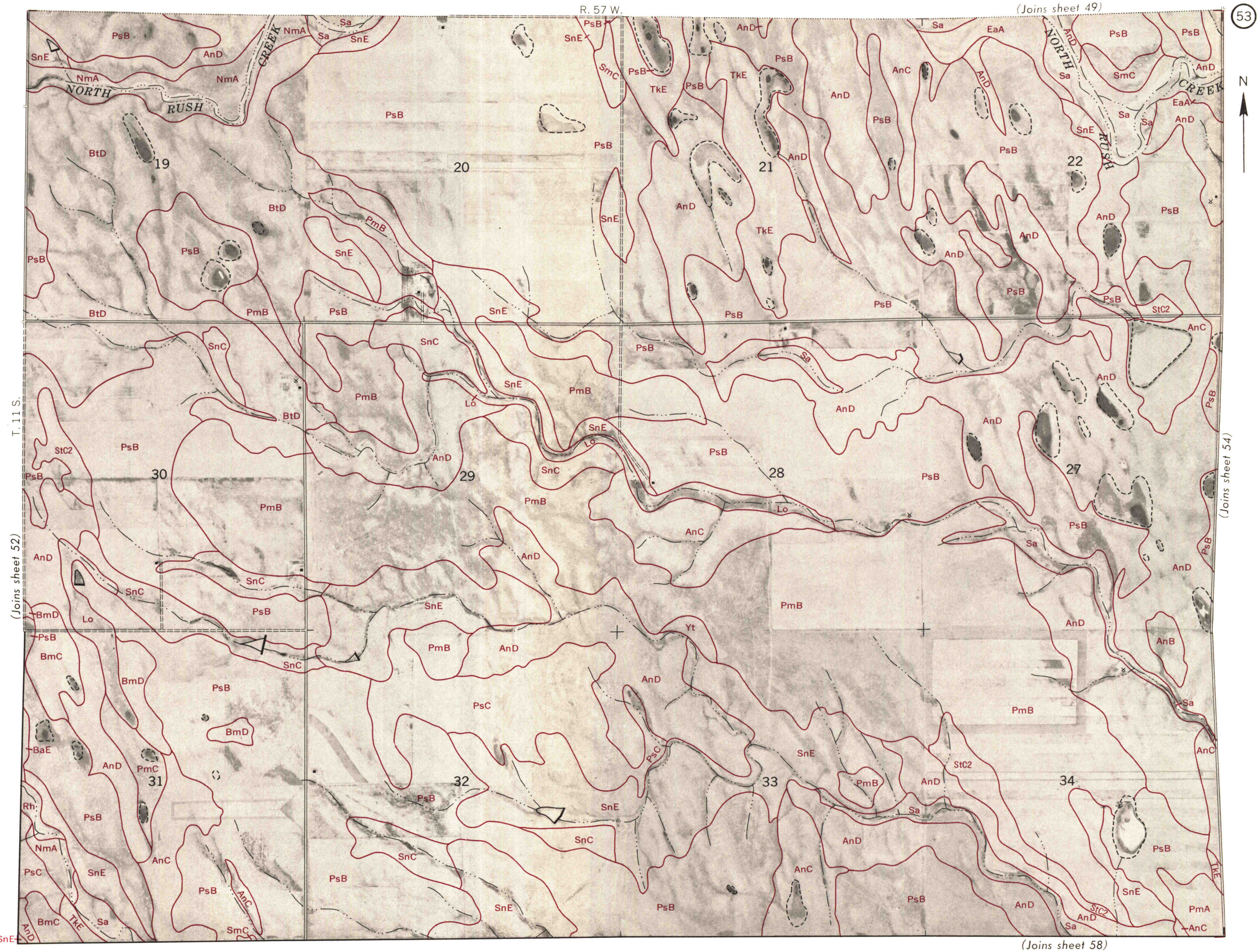
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

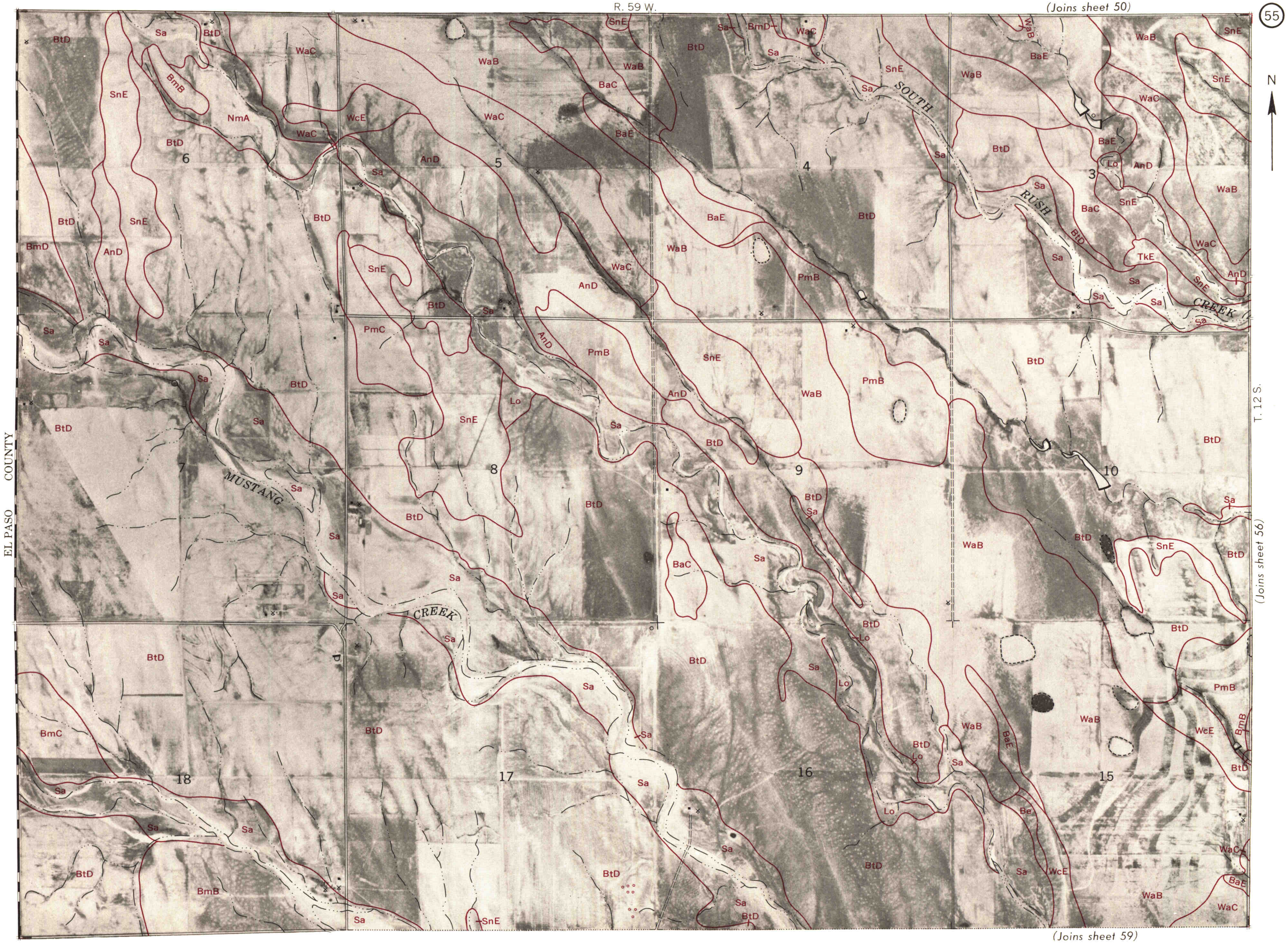
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 54

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

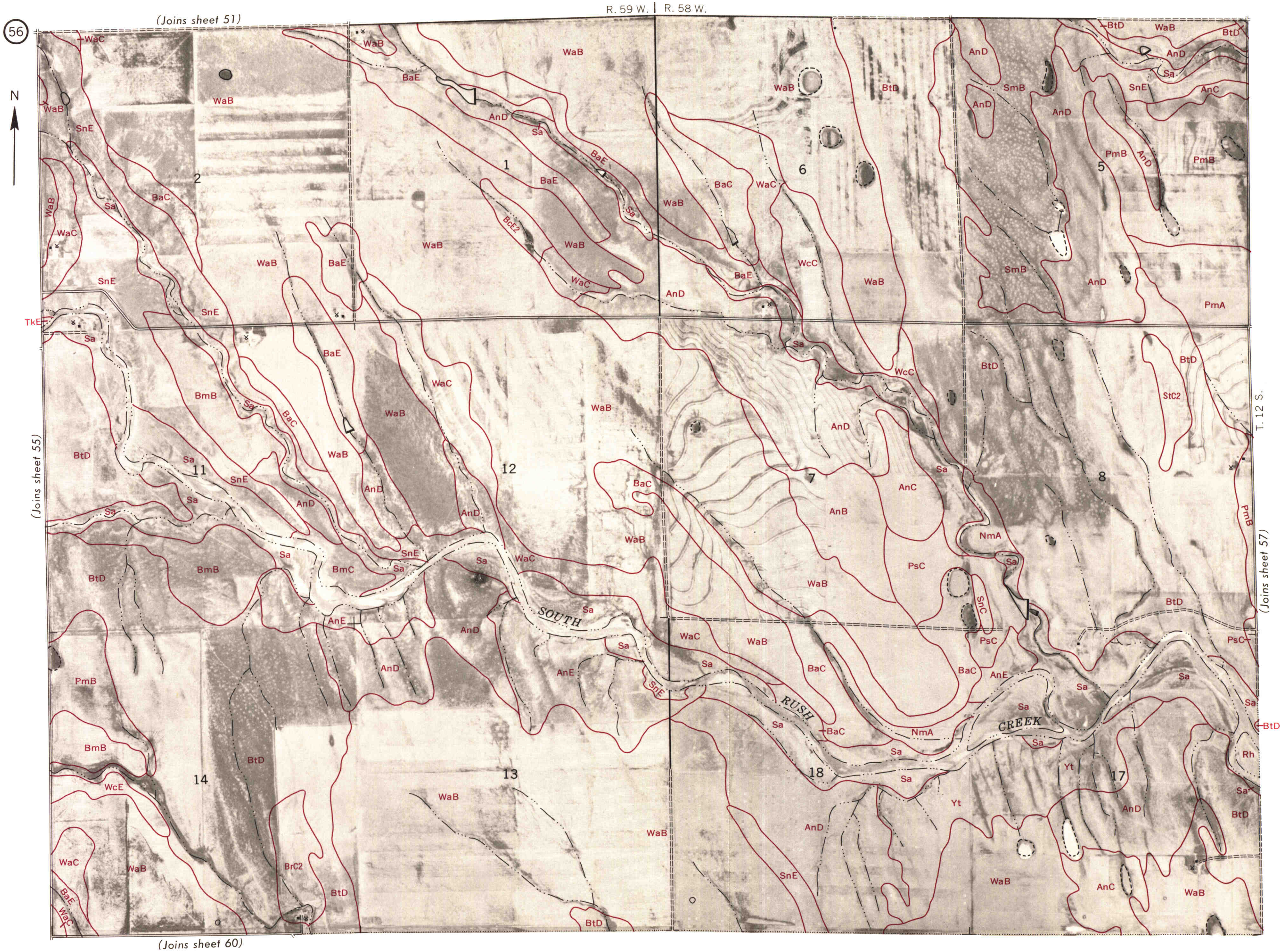
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

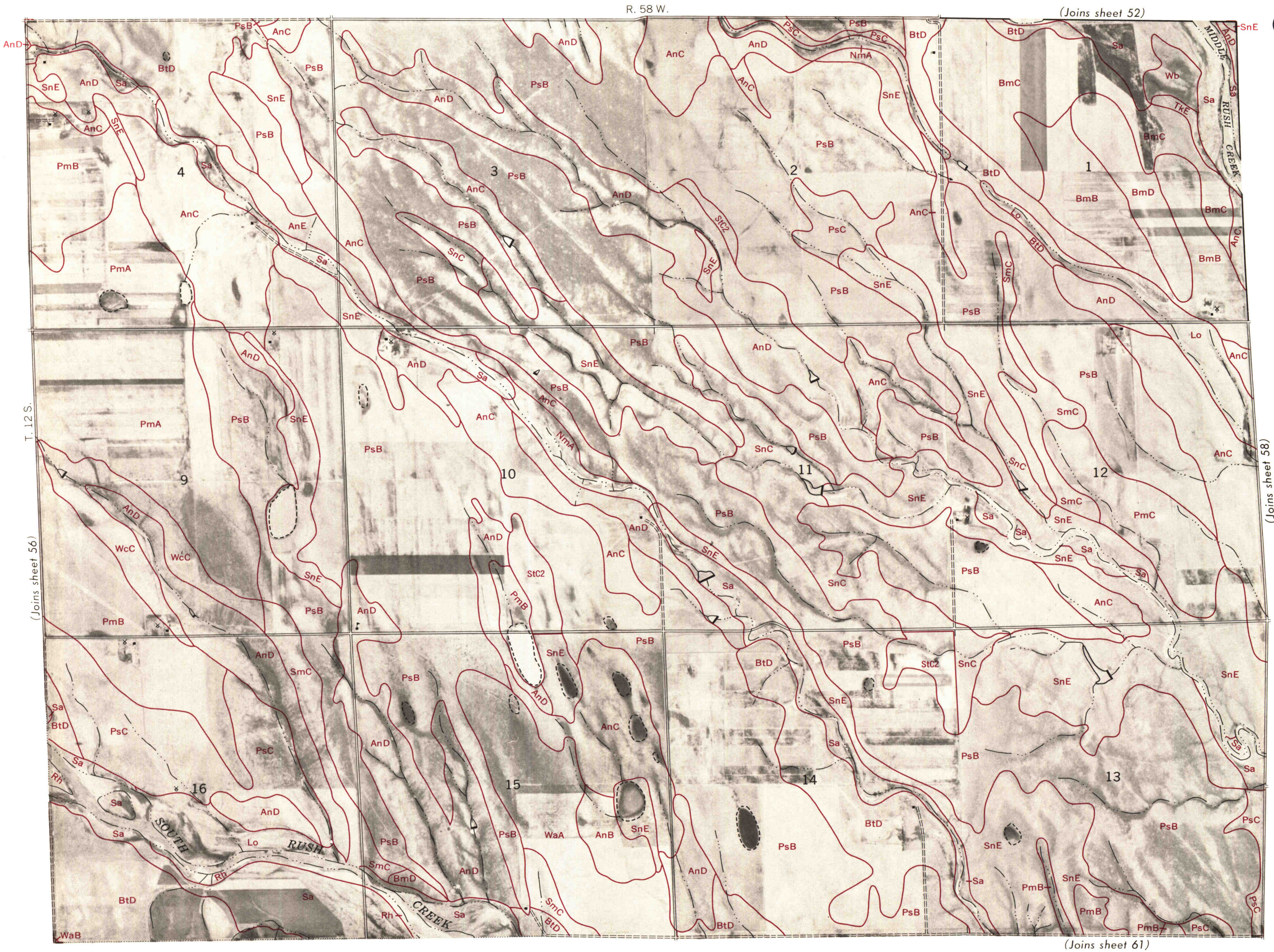


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 56



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

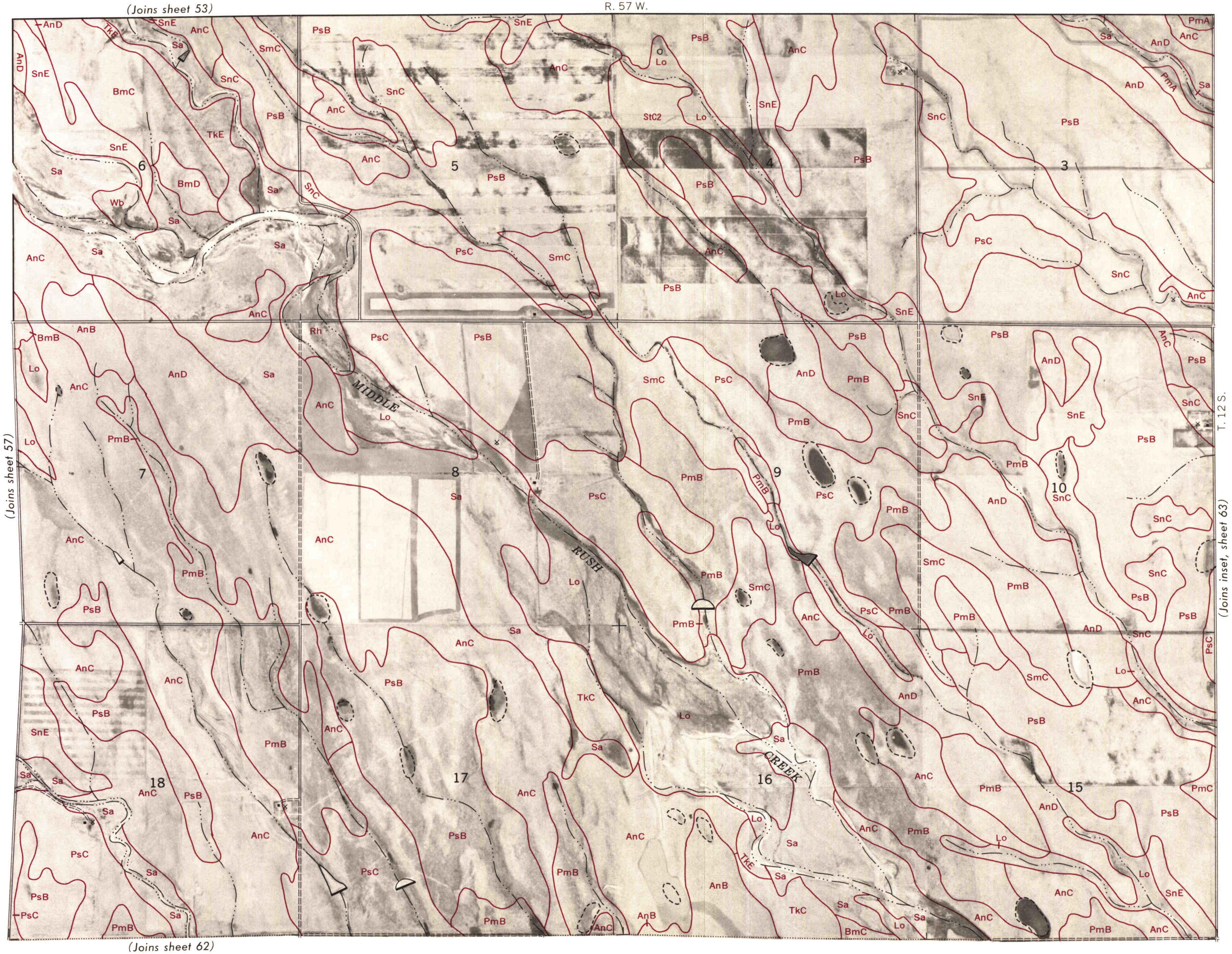


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

58



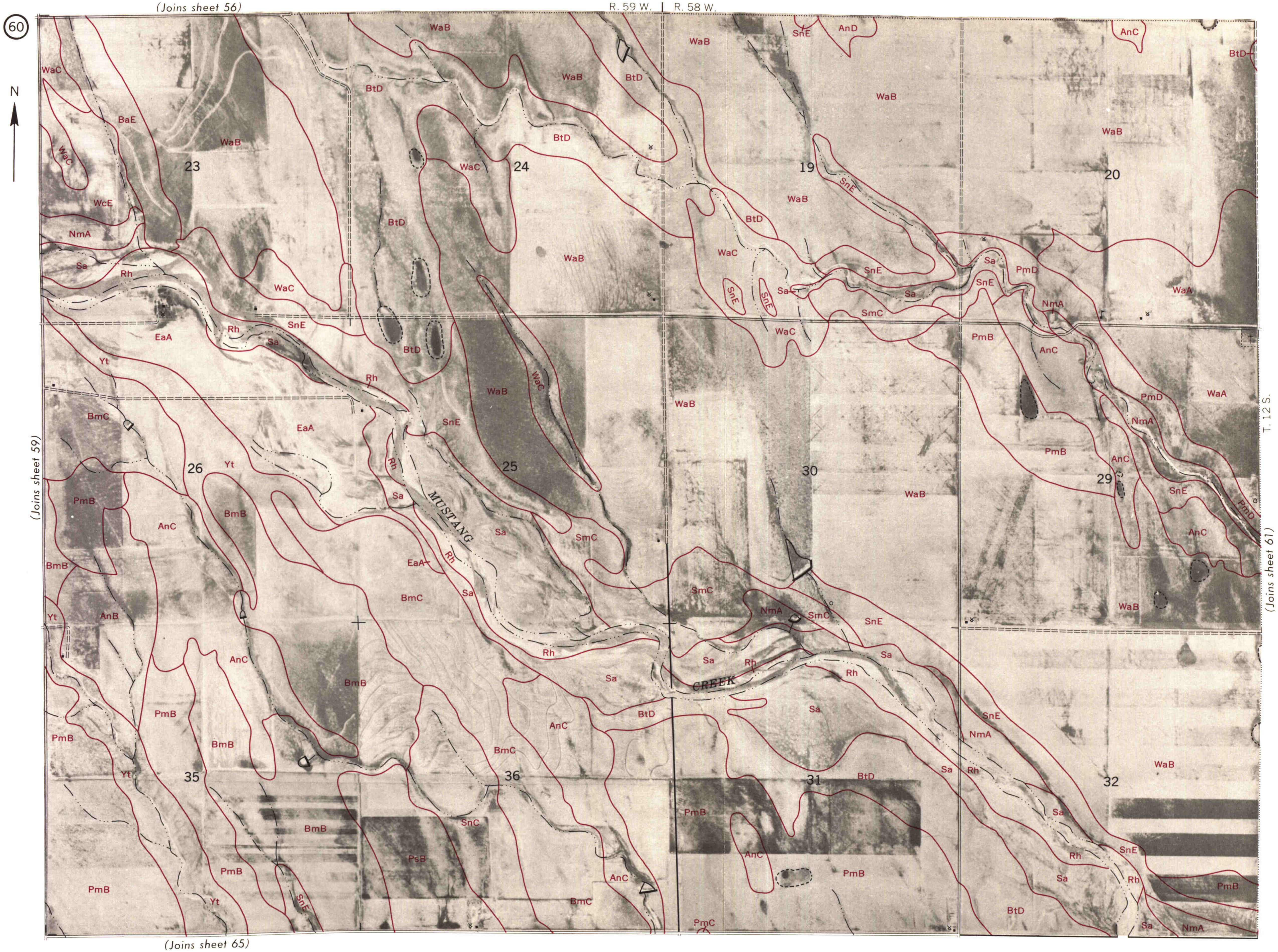
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 60

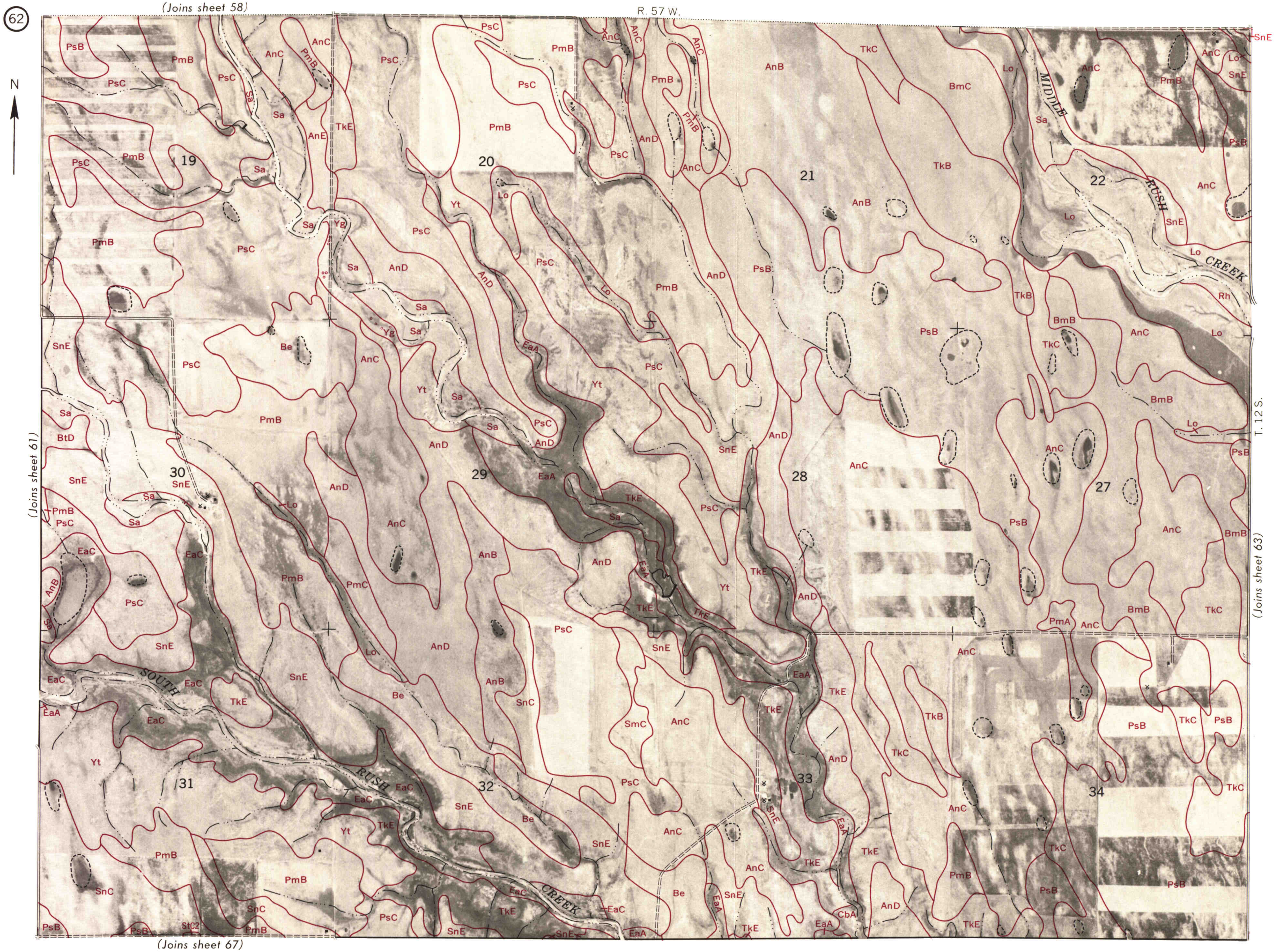


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

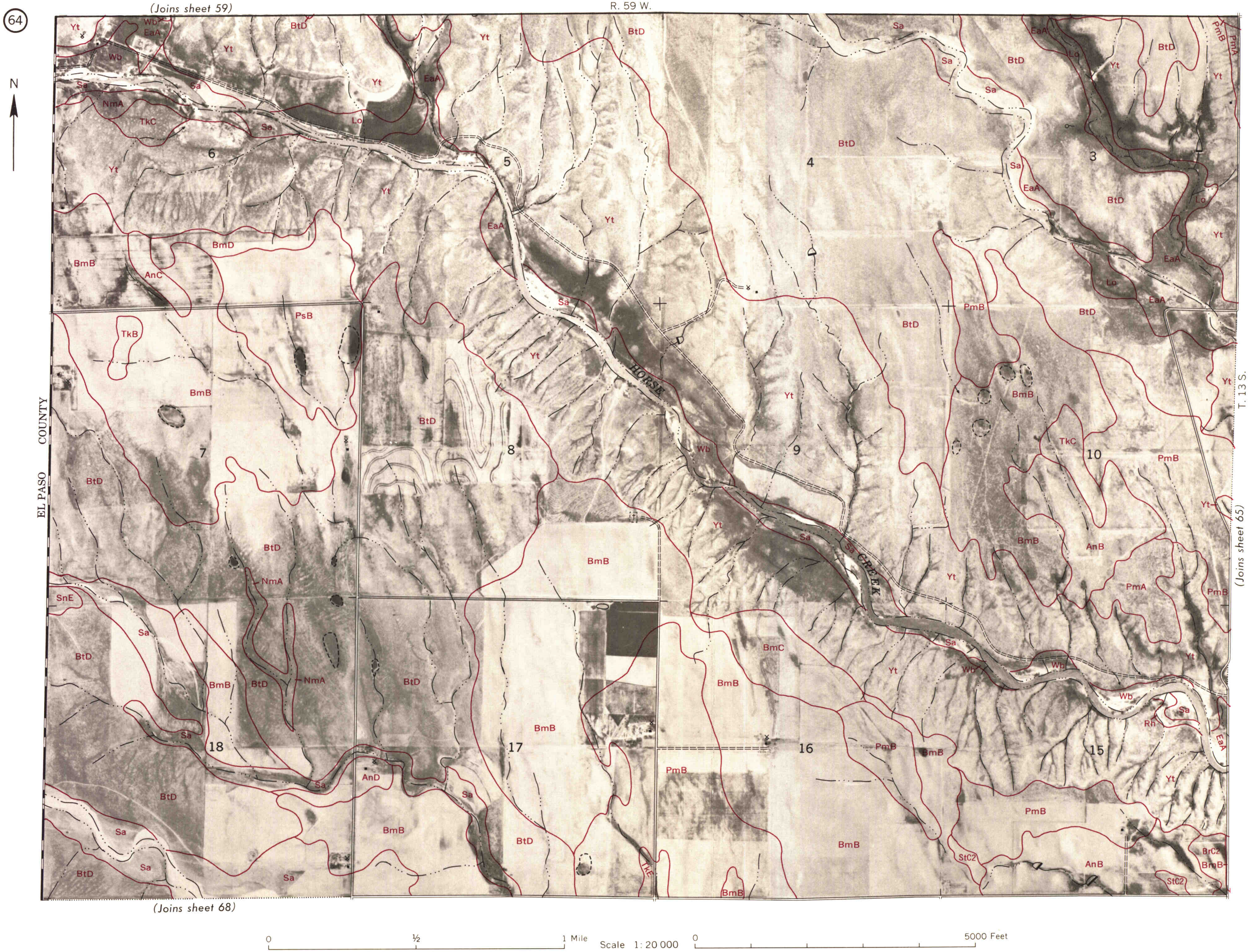
Scale 1: 20 000

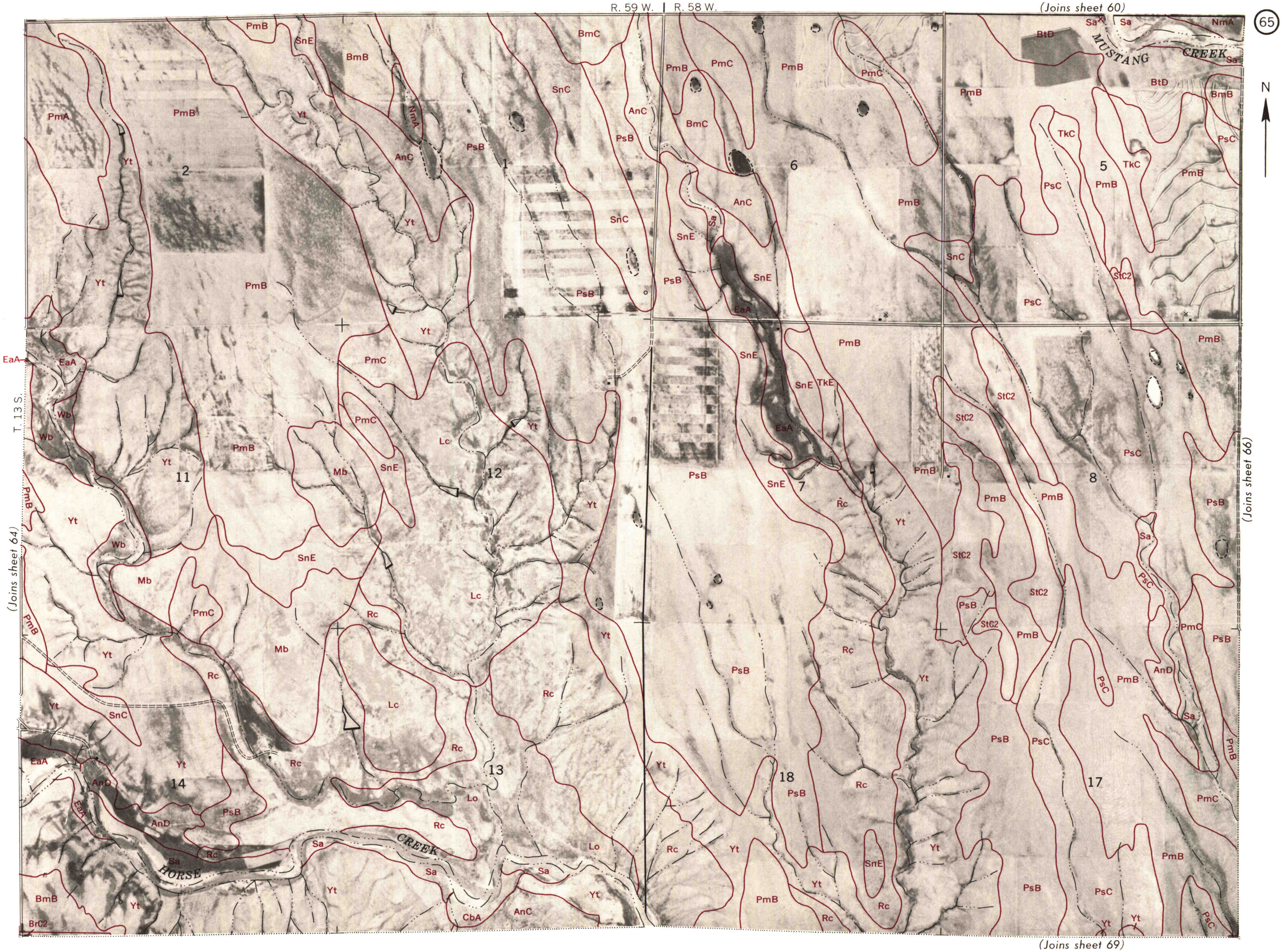
0 ½ 1 Mile

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

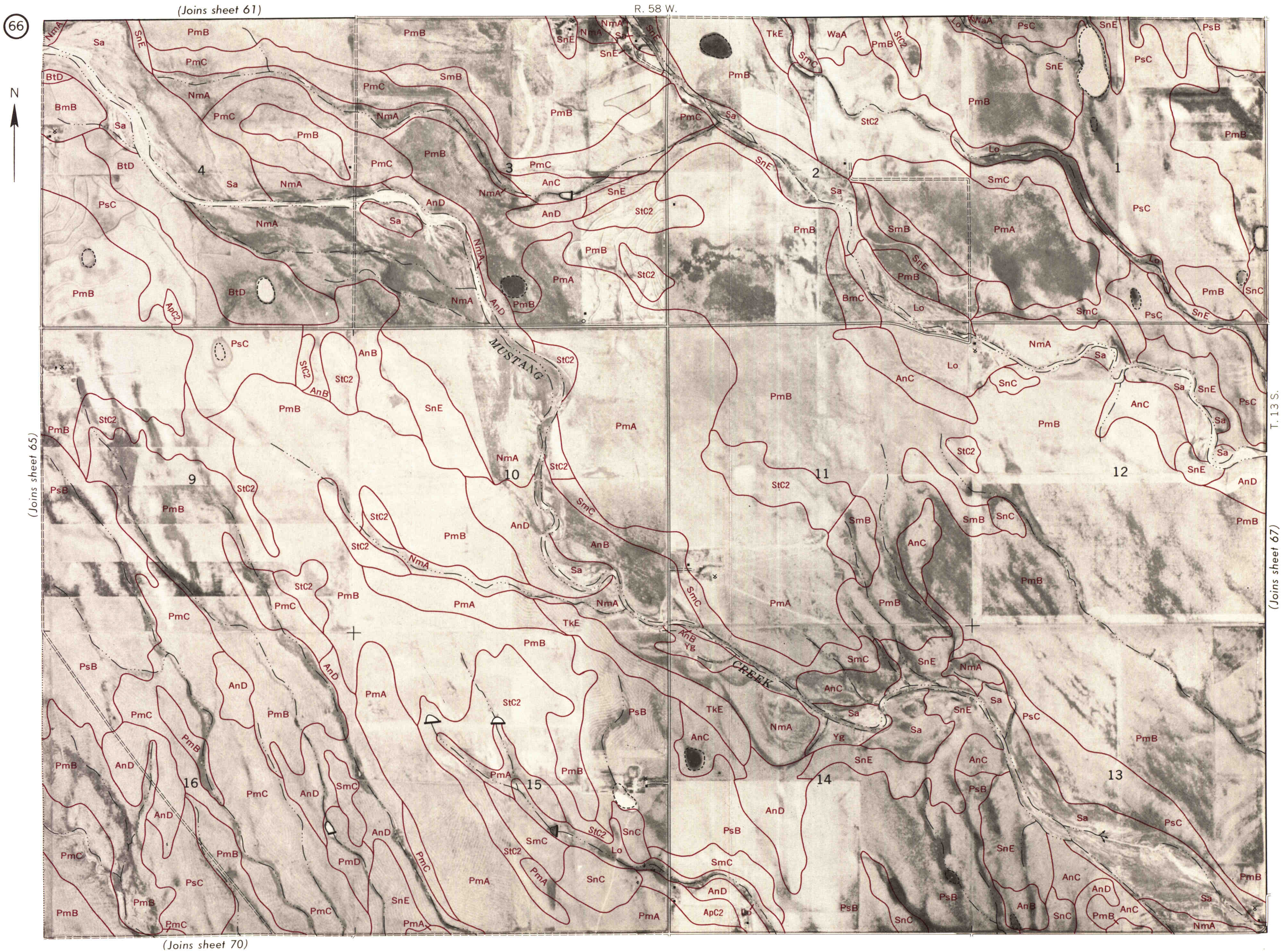

64
(Joins sheet 59)
R. 59 W.
N
EL PASO COUNTY
T. 13 S.
(Joins sheet 65)
(Joins sheet 68)
HORSE CREEK
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

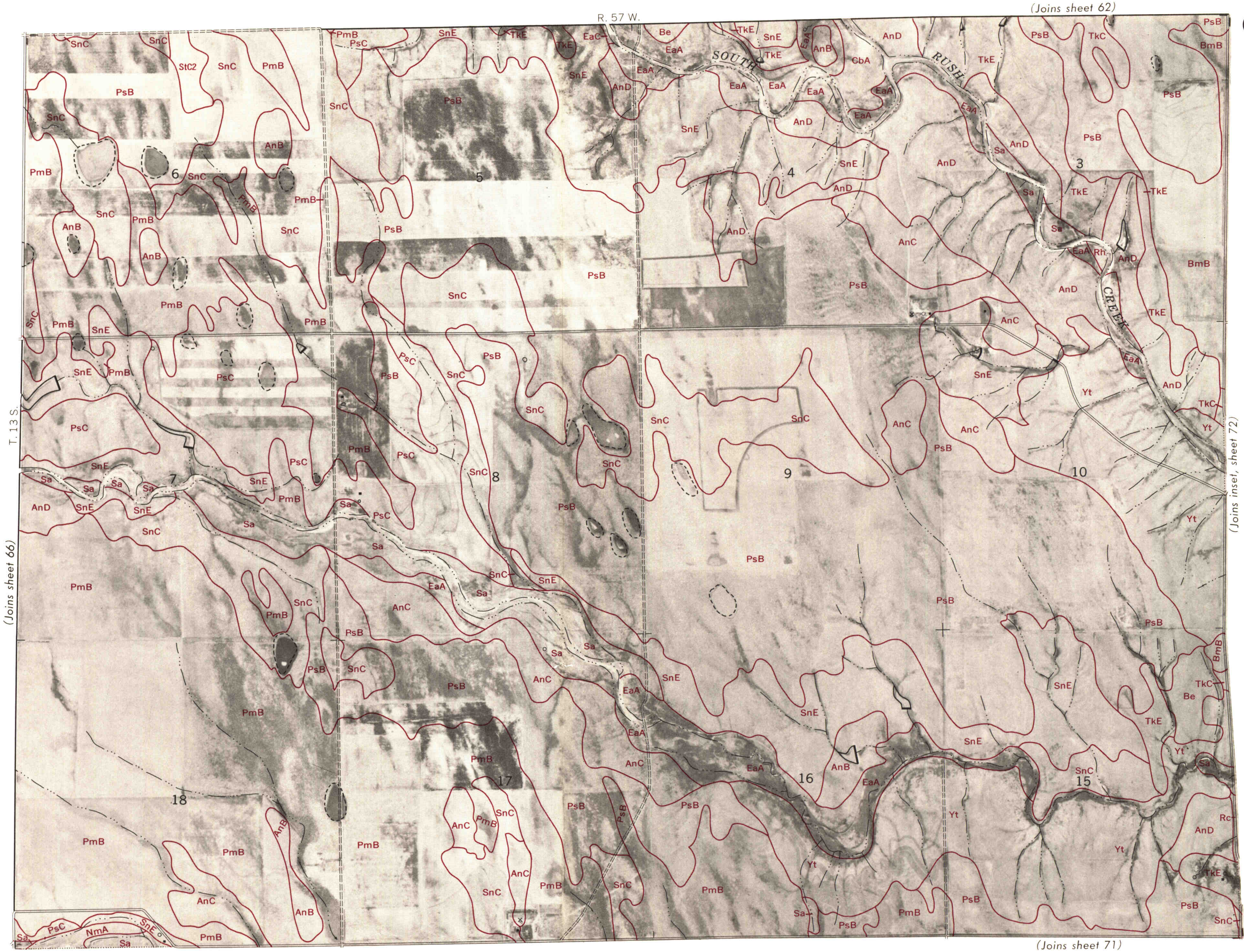
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

67



Scale 1:20 000

0 ½ 1 Mile

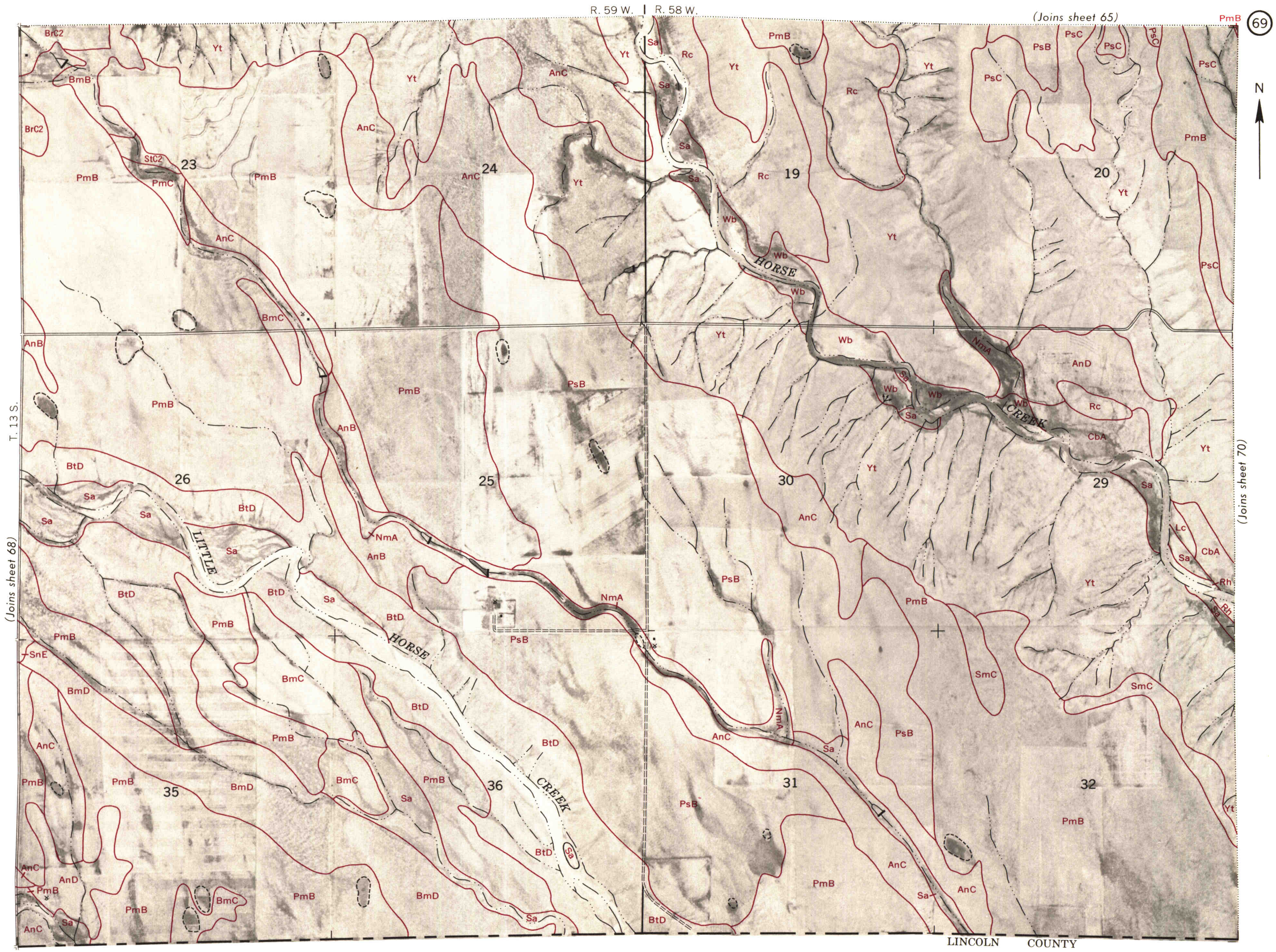
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


68
(Joins sheet 64)
R. 59 W.
N
T. 13 S.
(Joins sheet 69)
EL PASO COUNTY
LINCOLN COUNTY
LITTLE HORSE CREEK
19
20
21
22
27
28
29
30
31
32
33
34
Scale 1: 20 000
0
½
1 Mile
0
5000 Feet

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 69



Scale 1: 20 000

0 ½ 1 Mile

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 70

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

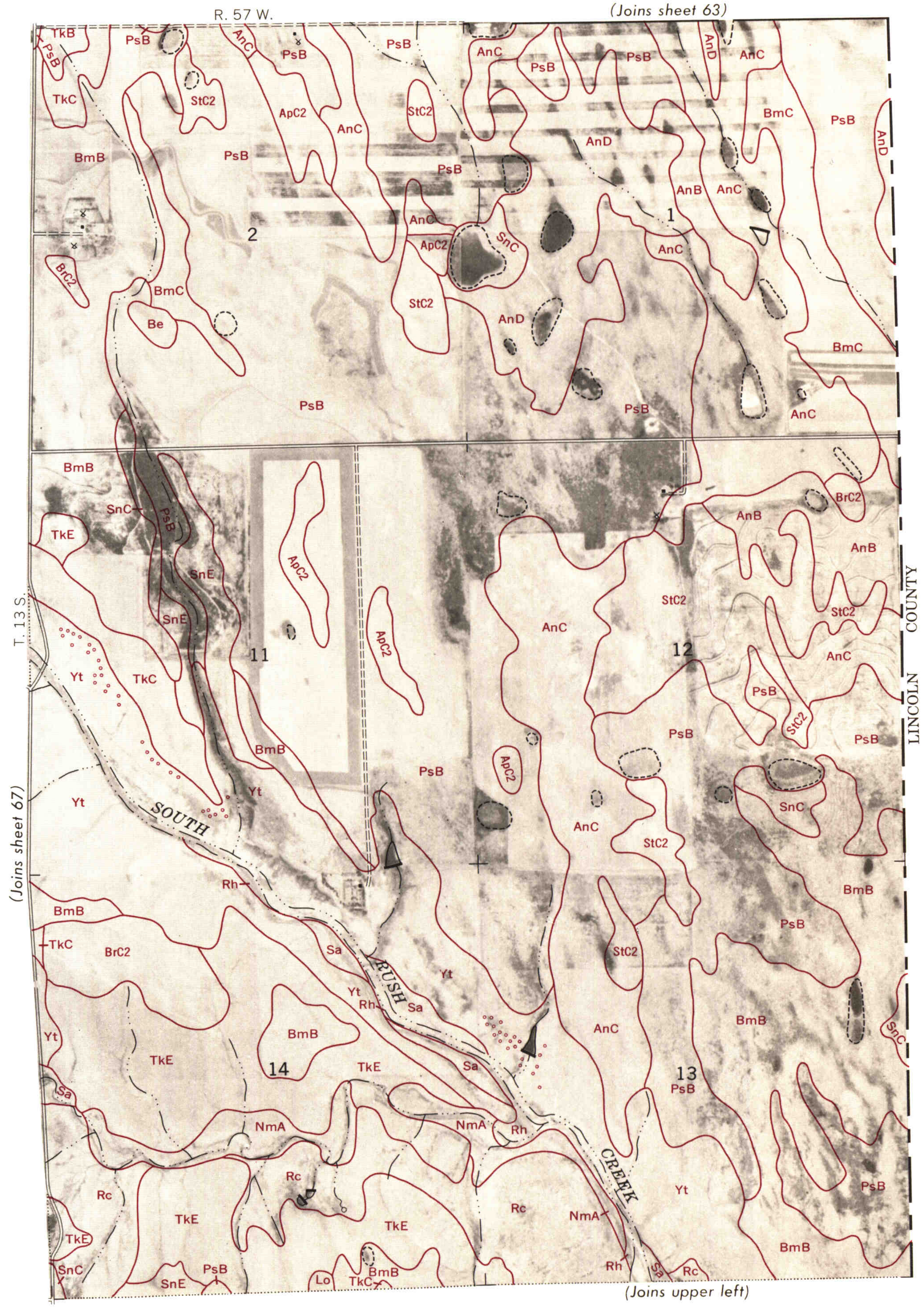
ELBERT COUNTY, COLORADO, EASTERN PART — SHEET NUMBER 71

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Colorado Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

72



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet